an international monthly

THE Petroleum Engineer

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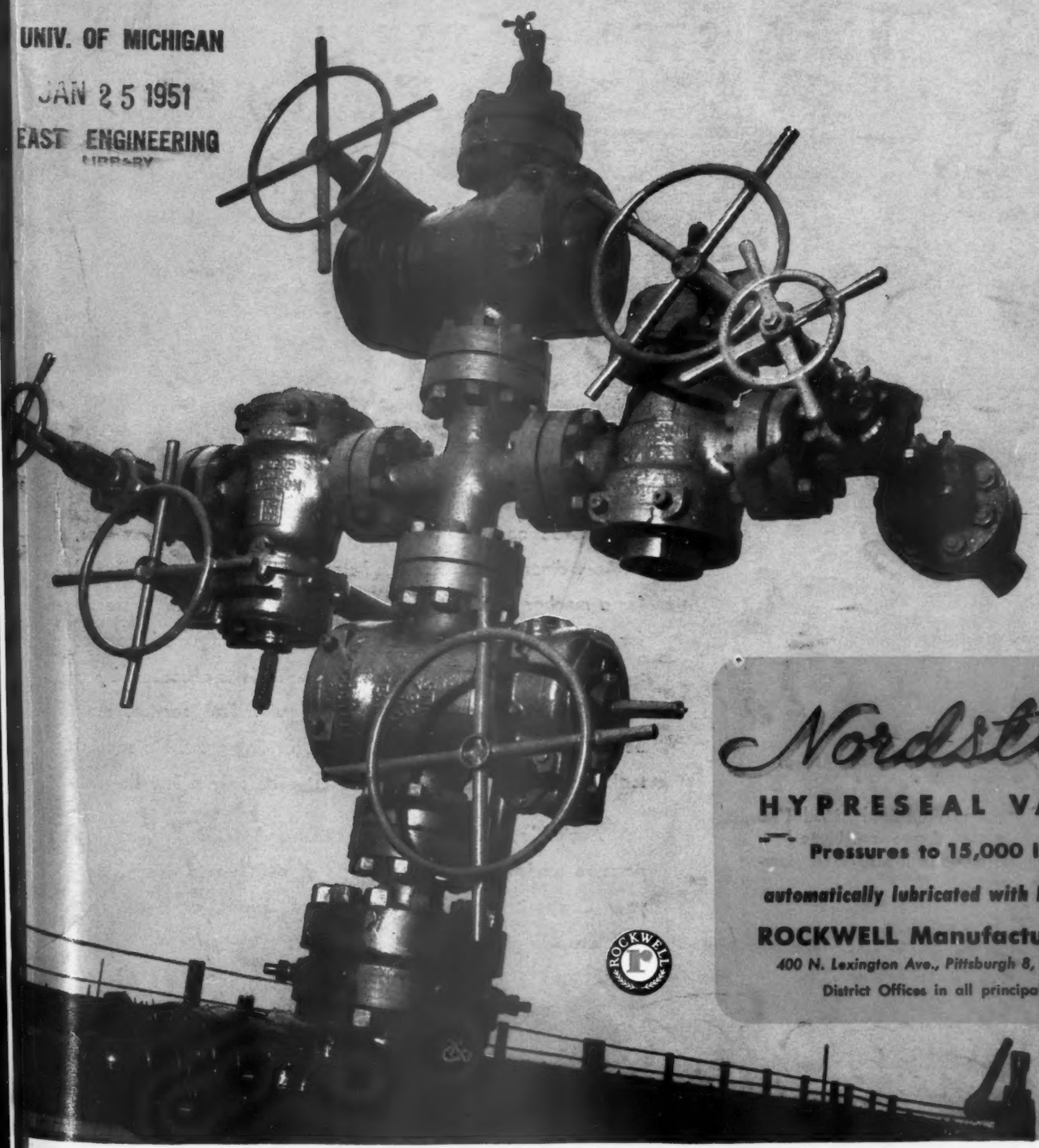

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JANUARY 1951

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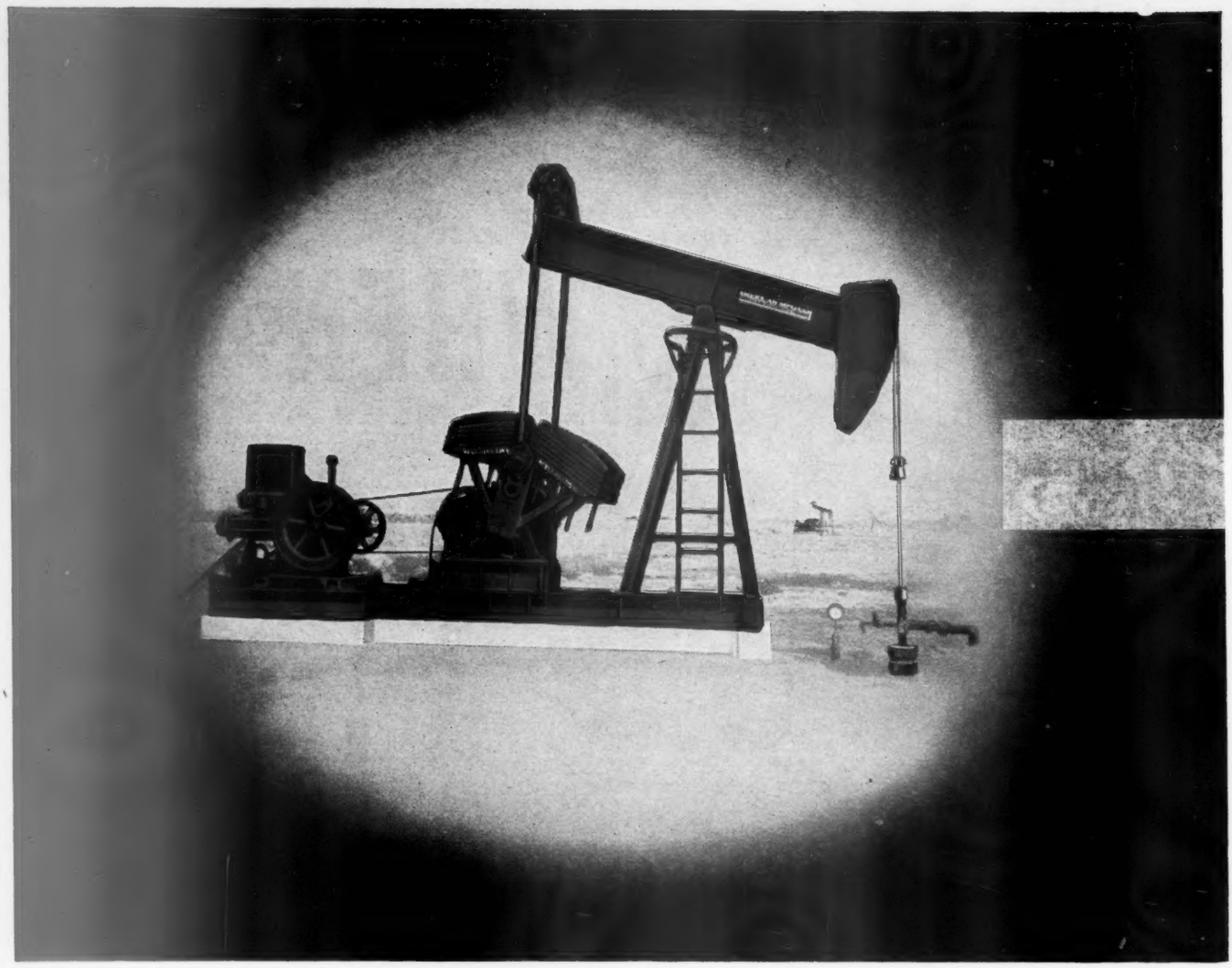

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• Drilling and Producing • Refining and Gas Processing • Oil and Gas Pipelining

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SPINDLETOP 1901-1951

FIFTY YEARS AGO, January 10, 1901, the famous Lucas Gusher blew in at Spindletop—America's first great oil well.

The Spindletop field was a behemoth from birth. Full grown it sprang into man's consciousness in the titanic image of the Lucas Gusher—a genie of the netherworld, powerful, promising.

The well and the field are synonymous.

There was oil before Spindletop but it was a tight little industry, future undefined, expansion uncertain. Spindletop showed the world that under its crust was motive power unlimited. It loosed the chains from an industrial revolution, and made possible the development of the modern petroleum industry, the petrochemical, natural gas, and sulfur industries, and many others.

Among the pioneers whose roots go back to Spindletop are the Gladys City Oil, Gas and Manufacturing Company, from whom Captain Lucas leased his land; the Higgins Oil and Fuel Company; Guffey Oil Company, now Gulf Oil Corporation; the Gulf Refining Company; the Houston Oil Company of Texas; and the Texas Fuel Company, now The Texas Company.

Spindletop today is flanked by refineries whose daily crude runs are more than ten per cent of the United States total. Magnolia, Pure, Atlantic, Texas, Gulf, Sun, and Stanolind join the host in pipe lines and storage and shipping. Spindletop boasts the world's largest tank farm. It still produces oil.

Although the entire year of 1951 will be devoted to commemorating the first discovery of oil on a major scale, the ceremonies planned during the week preceding January 10 will highlight the observance activities.

To assure appropriate observance of the event, Governor Shivers last summer appointed the Spindletop 50th Anniversary Commission as a non-profit, educational organization, incorporated under the laws of Texas. Its members are John W. Newton, chairman; I. F. Betts, F. L. Wallace, Phil S. Justice, W. W. Leach, C. W. Cooper, Scott Myers, Marion E. Brock, and Dr. A. M. McAfee.

During the ceremonies, a replica of the Lucas Well of 50 years ago and a complete modern power rig will be unveiled. The Exhibit Hall at the South Texas Fairgrounds will be formally opened and will contain the "Spindletop Exhibit of Progress," an educational and historical exhibit based on the theme "then and now." This exhibit will be maintained intact for several months and includes historical documents, photographs, graphic panels, dioramas, and as many examples as available of original tools, equipment, methods, and processes developed by the industry and displayed against a background of photographic murals of their present-day counterparts.

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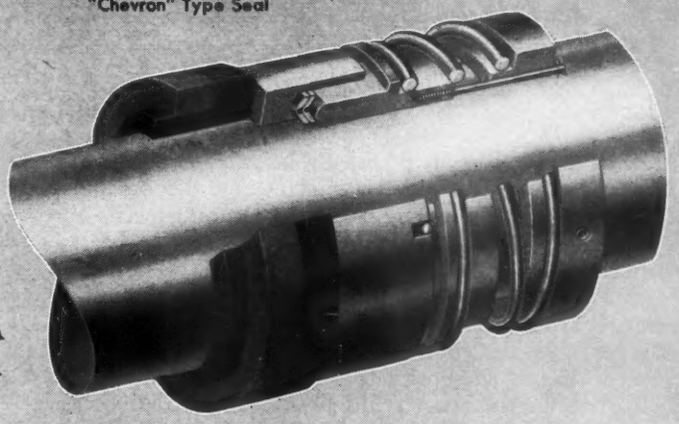

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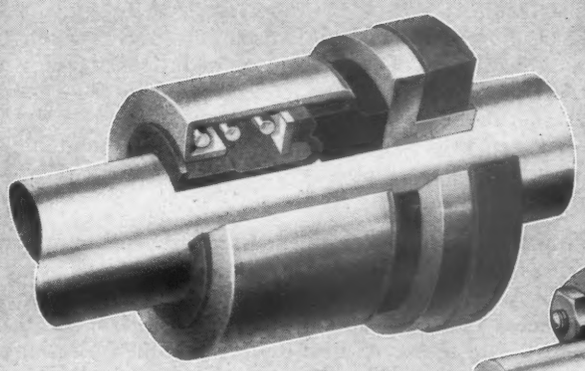

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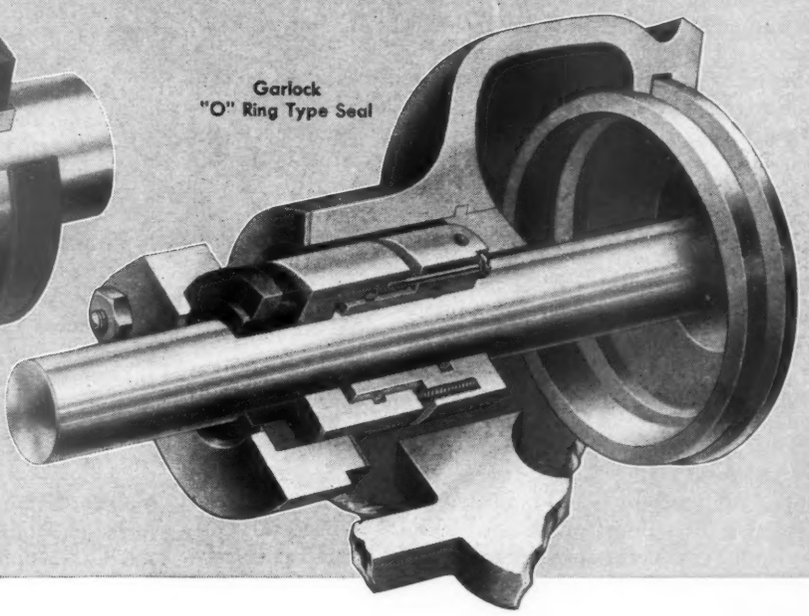

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Scanning WASHINGTON'S OIL HORIZON

Milburn Petty

WASHINGTON.—The petroleum industry is now practically on a wartime control basis with the hold-the-line policy on prices, a priorities system being set up on materials and the manpower problem becoming more acute.

Oil prices was one of the first fields to draw the attention of the Economic Stablization Administration, following President Truman's declaration of a national emergency and invoking price control powers.

Indeed, several days prior to this, ESA had called in, as an oil price consultant, Orville Judd, who headed OPA's oil price section for a year or so during World War II.

Judd immediately launched a study of the oil price situation and called on the industry to hold the line on prices of crude and products as they prevailed on December 8. Also, he called in California companies to discuss the 25-cent crude advance initiated December 12 by California Standard.

Meanwhile, Bruce K. Brown (Pan-Am Southern), the newly-appointed deputy petroleum administrator, is staffing the Petroleum Administration for Defense, mostly with personnel drawn from the industry, both majors and independents, so that PAD can start functioning on all cylinders.

▸ **Materials.** Mainly, PAD has been dealing with the materials problem confronting the industry.

A controlled materials program, similar to that of the last war, is being set up. Steel requirements for oil and gas have been tabulated and presented to PAD. But it may be months yet before the CMP program is fully operating. So, the PAD is working out two types of stop-gap programs.

First, there is the plan to earmark up to 5 per cent of monthly mill production of oil country tubular goods for completion of wildcat wells and drilling of necessary offsets. Under this plan, operators will sign statements certifying that they have not been able to obtain these items elsewhere and agreeing to return them if not used in 30 days.

The other program is to take care of urgent requirements of refiners for pressure tubing, steel forms and shapes, etc., to keep their plants operating or to complete facilities for making military products. Priorities assistance for petroleum equipment manufacturers to obtain materials will also be included in this program, PAD officials say.

▸ **Prices.** Just before ESA Oil Price Chief Judd began his study of the situation, Senator Maybank of South Carolina, chairman of the committee that handles controls legislation, issued a press statement saying that, in view of the industry's "highly profitable position" and the present "high" level of its prices, any further advances "would be difficult to justify."

Maybank said that he had information that price advances of 25 and 30 cents on crude and one cent on gasoline "are being considered." He urged the industry hold the line.

▸ **Pipe Lines.** There are now two proposals pending to build a "big inch" crude oil pipe line from West Texas to Los Angeles. Besides the one proposed earlier by the West Coast Pipe Line Company, with headquarters in Dallas, there is another project sponsored by Marc D. Leh and David E. Brown, both of Los Angeles.

Deputy Administrator Brown says that PAD will study these and other possible alternatives, including a line from Western Canada, in the light of military necessity and steel availability for such a project as compared with other demands for materials.

Meanwhile PAD has assured the gas industry that consideration will be given to the steel requirements for needed gas transmission lines. PAD's position is that gas may be able to supply some of the heating load, thus avoiding having to build refining capacity for this purpose.

▸ **Fuels Study.** Chairman O'Mahoney has asked for a two-year extension, until January 3, 1953, of the Senate Interior Committee's national fuels policy investigation under the Myers resolution. (This should kill any hopes that Senator O'Mahoney would let this fuels study die with the 81st Congress after defeat of its sponsor, Senator Myers of Pennsylvania.)

Fears have been expressed that this investigation may lead to recommendations for a national fuels policy that would include "end use" controls on oil and gas as a means of promoting greater coal consumption.

First step in this investigation will be a roundtable discussion by selected spokesmen for various fuels, to be held by the committee early in January.

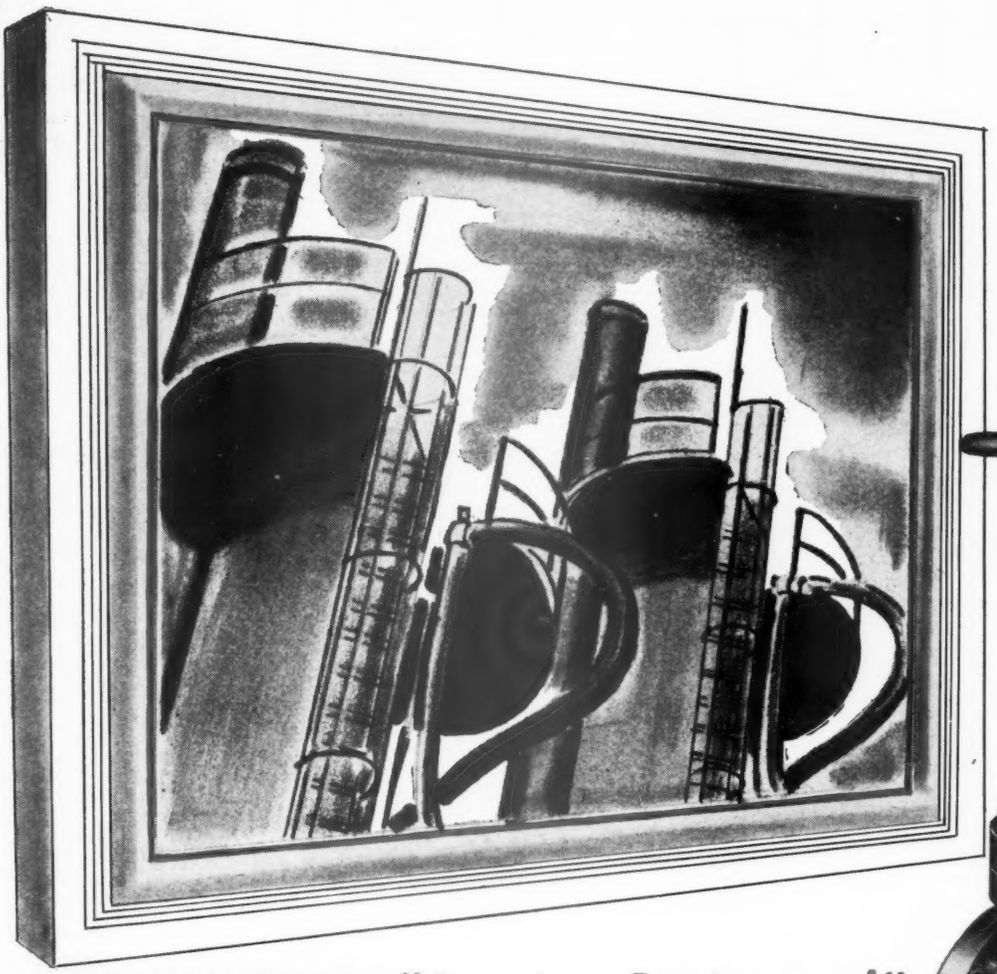
▸ **Tankers.** At the government's request, tanker operators are drafting a voluntary program under the Defense Production Act to supply the military's tanker requirements. It is expected that each operator will be asked to put up his proportionate share. At first there was some objection that foreign-flag tonnage should not be included in figuring an operator's share. But others argued that the volume of tonnage under the company's control should be the determining factor.

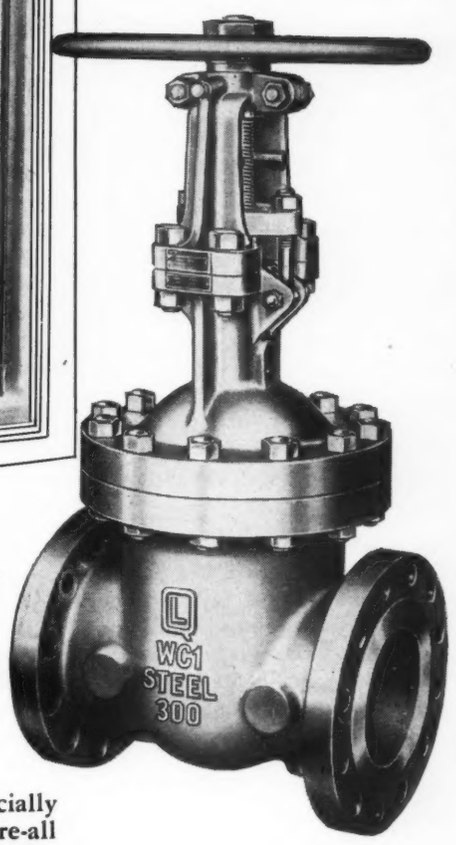
▸ **Gas.** Some representatives of natural gas producers believe that the Supreme Court's decision in the Cities Service Case, upholding Oklahoma's power to fix minimum prices for gas at the wellhead in the Guymon-Hugoton field may prompt other producing states to start fixing gas prices.

In a comparison case the court held that Phillips Petroleum Company, a producer only, was not violating the 7-cent minimum price order because the company realized that much on the gas taken from its own wells. This may suggest a way for the pipe line companies to realize higher prices on gas that they produce.

▸ **Drilling.** While gasoline rationing resulting from a supply shortage is not threatened by the mobilization program (with the military accounting for less than 5 per cent of total oil consumption), according to Deputy Administrator Brown, he warns that any shortage of tubular goods lessening drilling operations "would, in time, shorten the supply of oil." Brown went on to say, however, that he is hopeful that the drilling program can be supported with materials under present existing conditions.

▸ **Tidelands.** Renewal of the federal-state fight over tidelands in the new Congress may prolong the stalemate with the industry caught in the middle. But the military can be expected to break in with some sort of stop-gap plan if offshore oil operations are threatened with interruption. Interior Secretary Chapman has given offshore operators a 60-day grace period from December 11 (date of the Supreme Court's entry of the final decree against Texas and Louisiana in the tidelands suits involving these states) to continue operations under their state leases, meanwhile inviting negotiations for further continuances.





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PHILLIPS LOOKS AHEAD

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OIL STORAGE PROBLEMS

Storage facilities for oil products proved themselves when enough fuel was available to take care of even the most densely populated cities during the recent unprecedented snow storm in the east. Although this was a feather in the caps of those concerned with storage and distribution problems, it presages need for expanded facilities as demand expands.

GASOLINE USAGE UP

The American Petroleum Institute has reported that indicated consumption of gasoline was up 9.2 per cent in the first three quarters of 1950 in a 32-state area. Total gallonage in the area amounted to about 21,652,178,000 gal, compared with 19,820,098,000 in the year-earlier period, a net gain of 1,832,080,000 gal. Gains in consumption in the 32 states, ranged from 3.8 per cent for Wyoming at the lowest, to 16.2 per cent for Tennessee at the highest.

400,000 OIL WORKERS

Approximately 400,000 people are employed in the oil industry's production and refining divisions, the Bureau of Labor has reported. This is a little less than one employee for each of the nation's producing oil wells, now estimated at 445,000.

NO GASOLINE RATIONING

In the opinion of Bruce K. Brown, newly appointed deputy administrator of the Petroleum Administration for Defense, there is "no reason in the world why there should be rationing of gasoline." "Nothing short of bombings or blockades or other physical blows of war can drive gasoline or heating oil into scarcity," he said. "The problem we have now . . . is caused by the highly increased industrial tempo of the armament program," Brown informed the public.

ALBERTA OIL REVENUE

Oil revenue for Alberta, Canada in the last six months of 1950 amounted to more than $5,400,000 monthly, Premier E. C. Manning has stated. A total surplus of $65,000,000 is expected to be in the Alberta Treasury from oil development by the end of the current fiscal year. Much of the money is being used for capital expenditures and retirement of the public debt, reducing the public debt of Alberta by $56,000,000. There are now 55,000 acres of Alberta land under exploration and development with producing wells numbering some 1700.

FREE ECONOMY EFFECTIVE

Given adequate materials, an equitable tax base, and assurance of operating in a free economy, the American petroleum industry will meet all requirements of the national defense program. That was the conclusion of J. Ed Warren, president of the Independent Petroleum Association of America, speaking at the annual meeting of Rocky Mountain Oil and Gas Association. Warren told oil men that the "short breathing spell" the oil industry has had—free from government controls—since World War II has produced results so valuable that "the perennial petroleum pessimists have almost been silenced." He added that petroleum will play a "great and essential role" in the national defense effort. At this stage of the national preparedness program the "oil industry is able to say it is in reasonably good condition." He warned that only a free economy will provide the initiative necessary to stimulate continued expansion of essential exploration and drilling, and expansion of other defense industries also depends on petroleum.

STEEL PROBLEM GRAVE

Hope for definite action in solving a growing shortage of oil country steel tubular goods was contained in a report to members of the Independent Petroleum Association of America. Russell B. Brown, general counsel of IPAA, said a presidential order authorizing more manpower for the Petroleum Administration for Defense may hasten recommendations by that agency to correct the serious pipe shortage. He said J. R. Parten, Houston, Texas, who has been named PAD consultant, had described the oil country steel shortage as "one of the first and most serious problems" to be considered when PAD is fully organized.

SYNTHETIC OIL POSSIBILITIES

The Bureau of Mines has disclosed that more than 225,000 gal of gasoline have been produced at its coal-to-oil demonstration plant in Louisiana, Missouri. Purpose of the plant, Bureau scientists report, is to determine the feasibility of establishing a synthetic oil industry in this country to be operated by private industry. If this is established, the U. S. would be independent of foreign oil supplies in event of war, and could fill the country's demands for oil for centuries, the scientists reveal. Leslie L. Hirst, head of the plant, has stated preliminary estimates are that production costs will be not much higher than producing gasoline from natural petroleum.

SUGGESTS PRICE RISE

The oil industry must get its affairs in shape so that it will be able to supply such military and domestic requirements for crude oil as might arise in the event of full scale war, K. S. Adams, president of Phillips Petroleum Company, has stated. This goal cannot be reached under prices presently being received for crude oil, Adams believes. Right now, he added it is obvious that all costs of producing crude oil are rising, while the selling price has remained unchanged.

STATES LOSE TIDELANDS

The Federal Government has at last been given full dominion over the submerged oil lands off the coast of Texas and Louisiana. The Supreme Court adopted a final decree giving the Government this authority, and required the two states to give a "true, full, and accurate accounting" of all money derived from oil drilling since June 5, 1950. This was the date of the court's sustaining federal claims to the disputed area. The area off Louisiana extends seaward 27 miles, and the Texas area extends to the outer edge of the Continental shelf.

MILITARY OIL TOP SECRET

For the purpose of withholding information that might be of military importance, the armed services have stopped the release of reports on military requirements and supplies of petroleum products. The last release by the Armed Services Petroleum Purchasing Agency reported that they anticipated no difficulties in supplying requirements of the armed services for aviation fuel during six months that began January 1.

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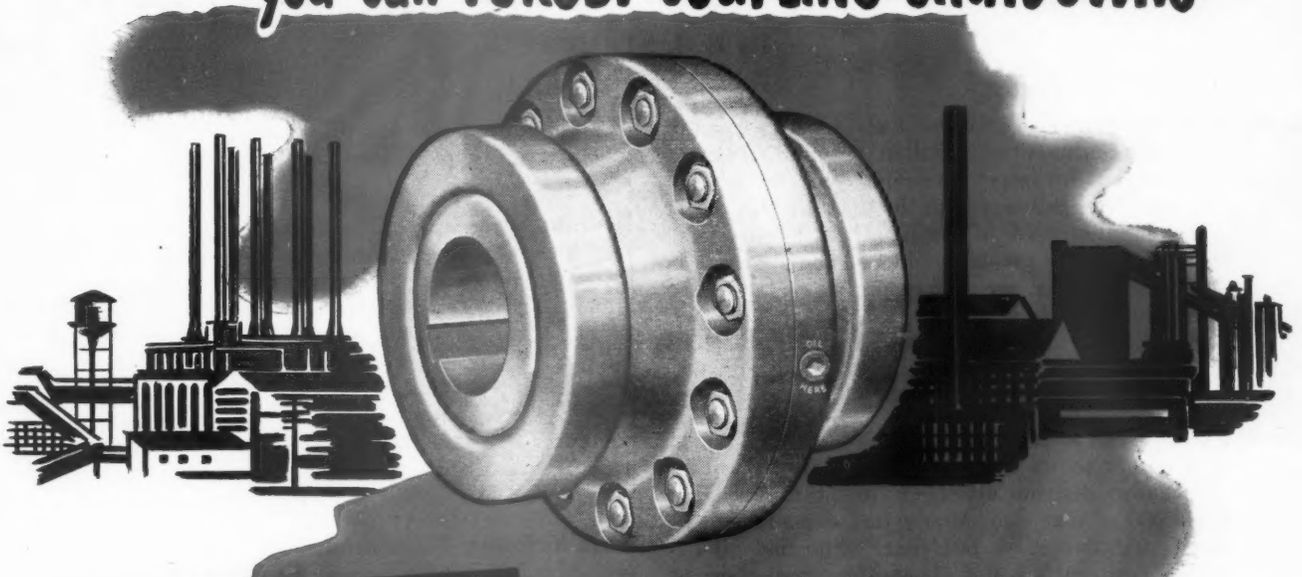

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National Petroleum Situation

By H. J. STRUTH*

Heavy Fuel Shortage. Persistent calls for more heavy fuel oils for both military and civilian requirements have strengthened markets for heavy crude oils. California heavy crude prices have been advanced for the third time in recent months.† Despite increased imports of heavy fuels from Caribbean refineries and greater output of heavy crudes in California and Wyoming, the supply of heavy crude and products has lagged behind demand. Stocks of residual fuel oils on December 2, according to the American Petroleum Institute, totaled 45,221,000 bbl, compared with 66,271,000 in the corresponding period of 1949.

Demand Up 10 Per Cent. Demand for all oils in the 11 months of this year shows an increase over last year of 10 per cent. November demand averaged 7,057,000 bbl daily, against 6,533,000 a year ago. Motor fuel demand for 11 months was 6 per cent above last year, while fuel oil demand was 14 per cent greater. Domestic production of motor fuel has been maintained in balance with demand but fuel oil production, plus imports, failed to meet requirements by more than 8,300,000 bbl. Even with the addition of transfers from crude oil, the supply has been short of market requirements. Fuel oil stocks are 15 per cent below a year ago.

Drilling Slow-Up. Difficulties experienced by oil operators in securing steel products are beginning to slow up drilling operations. November well completions were off 300 from October, while new drilling operations declined for the third successive month. Complaints from operators are multiplying and numerous instances are reported where lack of equipment has forced the suspension of drilling projects. The steel supply situation is being studied by P A D, but many operators object to the reintroduction of a system of government allocation, such as was imposed during World War II.

Peak Refinery Runs. Runs of crude to stills established a peak of 6,238,000 bbl daily during the week ending November 25. Runs reported by A P I for week of December 2 dropped back to 6,034,000 bbl daily. The average yield of fuel oil during the latest week was 40.5 per cent against 39.0 per cent during the week ending November 25. September Bureau of Mines report showed a yield of 38.9 per cent.

*Petroleum Consultant, Dallas, Texas.
†Latest advance rescinded by Presidential Order December 19, 1950.

Comparative Statistics, November, 1950

*All figures are computed on a Bureau of Mines' Basis**

	Nov. 1950Ⓟ	Oct. 1950	Nov. 1949	This Year to dateⓅ	Last Year to date	Per cent change
Total supply,* all oils	218,407	224,817	191,539	2,233,687	2,034,584	+10
Daily average	7,280	7,252	6,385	6,688	6,092	
Total demand,‡, all oils	211,712	205,082	195,988	2,224,961	2,018,131	+10
Daily average	7,057	6,616	6,533	6,662	6,042	
Change in stocks	+6,695	+19,735	—4,449	+8,726	+16,453	
Crude supply*	188,985	200,900	169,223	1,960,429	1,824,336	+ 7
Daily average	6,299	6,481	5,640	5,870	5,462	
Crude demand‡	186,295	197,250	164,022	1,967,075	1,825,076	+ 8
Daily average	6,209	6,363	5,467	5,889	5,464	
Crude stocks	247,840	245,150	256,010	247,840	256,010	— 3
Days supply	40	39	47	40	47	
Natural gasoline production	15,715	14,600	14,235	160,766	141,522	+14
Daily average	517	471	474	481	424	
Motor fuel production	87,300	91,300	79,733	931,415	878,276	+ 6
Daily average	2,910	2,945	2,658	2,789	2,630	
Gasoline yield, per cent	41.7	43.0	43.6	43.3	44.4	— 1.1
Motor fuel demand‡	85,920	87,300	78,536	927,864	875,022	+ 6
Daily average	2,864	2,816	2,617	2,778	2,620	
Motor fuel stocks	110,580	109,200	104,314	110,580	104,314	+ 6
Days supply	39	39	40	39	40	
Fuel oil production	73,700	75,880	64,282	743,192	695,076	+ 7
Daily average	2,456	2,448	2,142	2,225	2,081	
Fuel oil demand‡	87,920	73,930	78,228	858,642	750,306	+14
Daily average	2,997	2,385	2,607	2,571	2,246	
Fuel oil stocks	130,440	131,100	153,224	130,440	153,224	—15
Days supply	44	55	59	44	59	
Refinery still runs	183,850	190,700	158,782	1,902,981	1,775,796	+ 7
Daily average	6,128	6,152	5,293	5,698	5,317	
Stocks, all oil	606,890	600,195	622,196	606,890	622,196	— 2
Days supply	86	91	95	86	95	

Current Crude Oil Prices

U. S. average	$2.58	Louisiana	$2.62
Texas	2.61	Arkansas	2.43
California	2.42	New Mexico	2.40
Oklahoma	2.62	Mississippi	2.23
Kansas	2.62	Illinois	2.76
		Other states	2.60

Basic crude prices:

Oklahoma-Kansas (36 gr.)	$2.57
Texas Gulf Coast (36 gr.)	2.80
East Texas	2.65
West Texas (36 gr.)	2.44
California Signal Hill (26 gr.)	2.31
Pennsylvania, Bradford	4.25

Drilling and Production Statistics

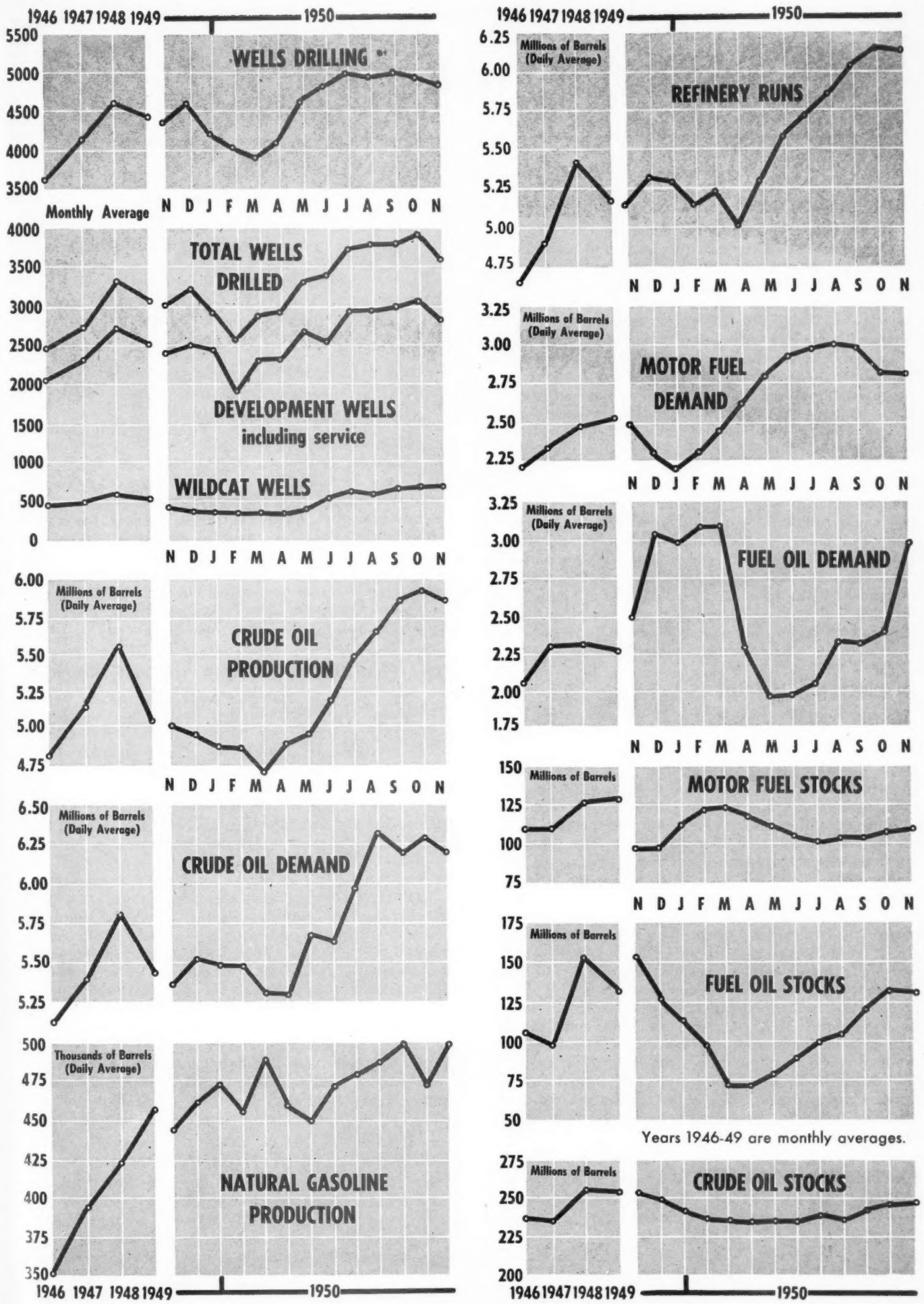
	Nov. 1950Ⓟ	Oct. 1950Ⓟ	Nov. 1949	This Year to date	Last Year to date	Per cent change
Wells drilling	4,860	4,940	4,770	4,860	4,770	+ 2
Total wells drilled	3,693	3,994	3,318	39,103	35,335	+11
Development wells	2,872	3,121	2,711	31,013	28,068	+10
Oil	1,880	1,994	1,785	20,824	18,850	+10
Gas	214	297	242	2,457	2,533	— 3
Dry	778	830	648	7,732	6,675	+16
Per cent dry	27.1	26.6	25.2	24.9	23.8	+ 1.1
Service wells	78	100	70	781	1,075	—27
Wildcat wells	743	773	537	7,309	6,192	+18
Oil	102	125	67	1,110	949	+17
Gas	17	28	15	216	168	+29
Dry	624	620	455	5,983	5,075	+18
Per cent dry	84.0	80.2	84.9	81.9	81.9	0

By States

Wells drilled (excl service)	3,615	3,894	3,248	38,522	34,260	+12
Arkansas	39	20	30	362	307	+18
California	151	175	210	1,684	2,336	—28
Illinois	269	318	268	2,696	2,392	+13
Kansas	336	427	314	3,456	3,018	+15
Louisiana	196	209	196	2,239	2,156	+ 4
Mississippi	19	26	25	286	309	— 7
New Mexico	59	42	40	566	446	+27
Oklahoma	470	468	392	4,882	3,878	+26
Texas	1,416	1,404	1,097	15,068	12,569	+20
Other states	660	805	636	7,283	6,809	+ 7
Wildcats drilled	743	773	537	7,309	6,192	+18
Arkansas	9	5	6	97	64	+52
California	37	45	29	397	450	—12
Illinois	67	63	55	623	481	+29
Kansas	59	88	42	710	472	+50
Louisiana	27	29	23	261	286	— 9
Mississippi	10	19	10	125	102	+22
New Mexico	4	10	4	72	73	— 1
Oklahoma	72	71	63	789	722	+ 9
Texas	343	287	199	3,047	2,630	+16
Other states	115	156	106	1,188	912	+30
Daily crude production	5,844	5,945	5,209	5,386	5,044	+ 7
Arkansas	85	87	85	86	82	+ 5
California	959	929	872	921	916	+ 1
Illinois	164	171	181	171	177	— 3
Kansas	309	313	288	300	279	+ 8
Louisiana	604	603	552	569	520	+ 9
Mississippi	108	106	101	105	105	0
New Mexico	147	131	132	132	131	0
Oklahoma	495	500	433	450	415	+ 8
Texas	2,555	2,702	2,181	2,277	2,040	+12
Wyoming	179	168	128	164	128	+28
Other states	239	235	256	211	251	— 16

* Unless otherwise stated all figures represent thousands of barrels. ‡ Total demand, including exports. * Includes domestic production and imports. Ⓟ Preliminary.

Preliminary estimates based upon data supplied by American Petroleum Institute, U. S. Bureau of Mines, State Agencies, and other official sources.



Years 1946-49 are monthly averages.

PETROLIC PERSONALITIES

DICK SNEDDON

API HANGOVER

We are not yet sufficiently recovered from the Los Angeles version of an API Convention to be able to cite all the details, but it was undoubtedly a whingding of rather more than major consequence. The second floor of the Biltmore Hotel has never had such a pounding since the famous hostelry was originally constructed and still trembles spasmodically like the earth after a big shake. The endless stream of delegates that wended persistently from one room to another throughout the hectic four-day session soaking up information and stuff is reputed to have surpassed all prior endless streams both in endlessness and wending.

The countless exhibits that were there obviously to apprise the uninformed expressed more real ingenuity than is represented in the Patents Department at Washington, D. C. There were decks of cards you could peek through and see the most amazing educational things; there were little books you could ruffle and learn still more amazing things, but these were mostly on the subject of anatomy and after our thumb became sore ruffling the little books we soon tired of the practice. Macco Corporation had one of the most educational exhibits in the whole place. It was a miniature pumping well that produced one jigger of Bourbon with every stroke of the pump. You'd be surprised to know the number of people who were educated by this device.

PERSISTENT WENDERS

Being one of the most persistent wenders in the endless stream already mentioned there was little that escaped our eagle eye. We called so frequently on M. O. Johnston, Bill Bettis, John Flanagan, Norm Andrew, and all the Johnston cohorts, including M. O. Jr. and Warren, in their convention headquarters that two operators have since asked us to come out and test their formations. Incidentally, Warren, the junior scion of the Johnston dynasty, has acquired a much enlarged repertoire of legerdemain and black magic, and as likely as not will soon be assaulting the pedestal on which Karl Zamloch has been perched so long.

We made several calls on the Kobe kontingent in the early part of the proceedings up in the quiet of the third floor, and if we do say so ourself we certainly kept their horses doovers from becoming a nuisance to them. Also, of course, we traded greetings with Kobe himself, Les Wold, Joe Siegel, Pete Slater, Red Elnar, Ross Lyons, John Hopkins, Chief Engineer McArthur, and while we were there met such petrolic luminaries as Jim Gosline, Standard of Cal production biggie from San Francisco; Bob Pyles, the Southwest Exploration production chief from Huntington Beach whose excellent work in the installation and care of mountain homes for California boys is beginning to attract national attention.

EXPENSIVE TOSS LOSS

Among eastern greats with whom we consorted variously during the hectic four-day session was Carl Joys, assistant to the president of A. O. Smith Company at Milwaukee, Wisconsin, and one of the few oil people who know the exact components of a St. Louis stinger. Just prior to the opening of the API convention, Carl had the misfortune to lose a toss to Joe Taylor, the Socony Vacuum Company purchasing agent from New York, out at the Annandale Country Club. Later he was informed that he had been tossing for the doubtful privilege of buying and serving appropriate libation for the sizable group of delegates who loafed on the lawn—not once, mind you, but for the rest of the afternoon.

Included in the participating group were Manley Brown, sales manager of the pipe division of Republic Steel Corporation from Cleveland, Ohio, a companionable sort of a chap with a raft of interesting experience and enough incidental anecdotes and adventures to enliven any party; Paul "Heavy" Barton, president of Jones and Laughlin Steel Barrel Company, a quiet unassuming fellow, but apparently not quite so quiet as he appeared as he was in some of the swashbuckling sales yarns told by the Taylor-Brown duo; Joe Hacker, vice president of Ladish Steel Forge Company, Cudahy, Wisconsin, whom we last saw at the Rancho Santa Fe course down at Del Mar earlier in the year. Joe is much feared by the weaker exponents of gin rummy at which he is reputed to be sharper than a two-edged sword; and then there were sundry local Nineteeners like Paul Whitely who makes the equipment salesmen sit out in the reception room for General Petroleum Corporation, and Martin Newell who does the same thing for Tide Water Associated.

LOU HARRISON FOUND IN THE ROUGH

It appears that the Nineteeners were having their monthly golf tournament and this gallery sat on the ramparts for most of the afternoon, hurling words of encouragement so-called at the contestants as they sliced and hooked their devious ways through the gorgeous grounds of the Annandale Club. Before the ribbing had gone too far, Archie MacDonald, the well known golf course excavator, arrived carrying a gadget that looked very much like a pogo stick. In any case it provided amusing conversation for some time and was finally discovered to be one of these portable stools that the British nobility usually take with them to Epsom Downs.

To return to the beam, we noted that ganged up with the local divot tossers were such national figures as Henry McAdams, New York manager for Jones and Laughlin, current prexy of the New York Nomads, and a clod heaver with a pronounced scientific bent. It is said that Harry once put four golf balls under a setting hen and was pleased no end when it hatched out three birdies and an eagle. Also wandering through the traps with astonishing abandon was Lou Harrison, eastern sales manager for Ladish Steel Forge Company in New York. It hasn't been noised around but our Annandale Club operative tells us that when the groundkeepers went out the next day to trim the rough a bit, they found Lou still hacking away from the day before.

IS SOUNDNESS A HANDICAP?

A really proficient performer from the New York area was Harry Lees, vice president of Jones and Laughlin Steel. Harry wound up with an 80 or some such professional total, and so, having learned that he was a hotshot at the game we asked him if he had any advice to give to the beginners, and he proffered the following gem: No novice should permit himself to be distressed if he doesn't become

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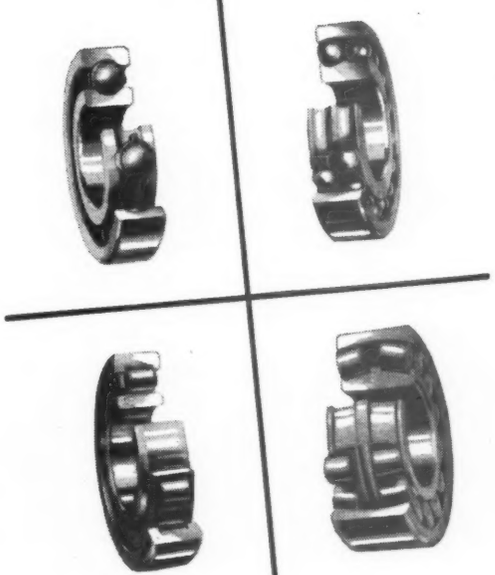

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adept at the game of golf within a reasonable time—after all, it is possible that he is just too sound mentally. It was soon remarked that the most violent commotion on the course was occasioned by the presence of that pair of irrepressible and inseparable Texans, Ed Trout, vice president of Lufkin Foundry and Machine Company, Lufkin, Texas, and Al "Dutch" Zwerneman, the Atlas Pipe person from Houston. These twin behemoths simply went through every obstacle with the crushing force of a pair of D-8 bulldozers, leaving behind them a wake of destruction as wide as the path of a Kansas cyclone. They were too exhausted by these exertions to go beyond the 9th hole but were able to take a lively interest in the indoor exercises that chewed up the rest of the day.

BILL FARRAND WINS SHIRT DERBY

Vividly outlined against the delicate greens of the landscape was a splash of riotous color that upon closer investigation turned out to be Bill Farrand, vice president of Texas Company from New York, plus a sports shirt. And what a sports shirt! In the very heyday of his kaleidoscopic color extravagance even George Trembley would have looked anemic against this creation. How Bill played is quite insignificant. That shirt literally paled everything else, even his score, into colorless inconsequence.

Noted during the day, darting stealthily from tree to tree, like Hopalong Cassidy on the trail of a rustler was that intriguing Houstonian, Eddie the Fish, or as he is known at home, Ed Fisher, representative of Pacific Wire Rope. Here is a paradoxical laddie who was born in England but is more Texan than a Texan. He landed out at the Club accoutered in the full regalia of the Lone Star folk, and his attractive lingo furnished some genuine entertainment at the evening banquet.

MORE PETROLIC CELEBRITIES

Other celebrities who added to the general enjoyment of a thoroughly enjoyable occasion were Bill Heilig, vice prexy and chief engineer of William Powell Company of Cincinnati, Ohio, and Tom Pike, western sales manager of Tube Turns, a pair of personable people who fitted into the party as unobstrusively as the last pieces in a jig saw puzzle. Then there was Dudley Fields, assistant purchasing agent for Arthur J. McKey Company, Cleveland, Ohio, in California on some kind of assignment for Union Oil Company, an easy-to-know kind of fellow who was also quickly absorbed into local petrolic society; Bob Smith, eastern representative of Norris Stamping Company and guest of Ken "Thermic Ray" Norris himself, who, however, was unable to be present, but Bob had a good time anyway. So also did Dick Townley, the C. F. Braun Company western sales manager from San Francisco, and John Braun of the same institution, a pair of lads with plenty of experience in the ways of their brothers from the deep California south, and consequently able to defend themselves against any kind of onslaught, whether it employs golf sticks, picture cards, or spotted cubes.

WHAT GOES ON IN THE SHOWERS

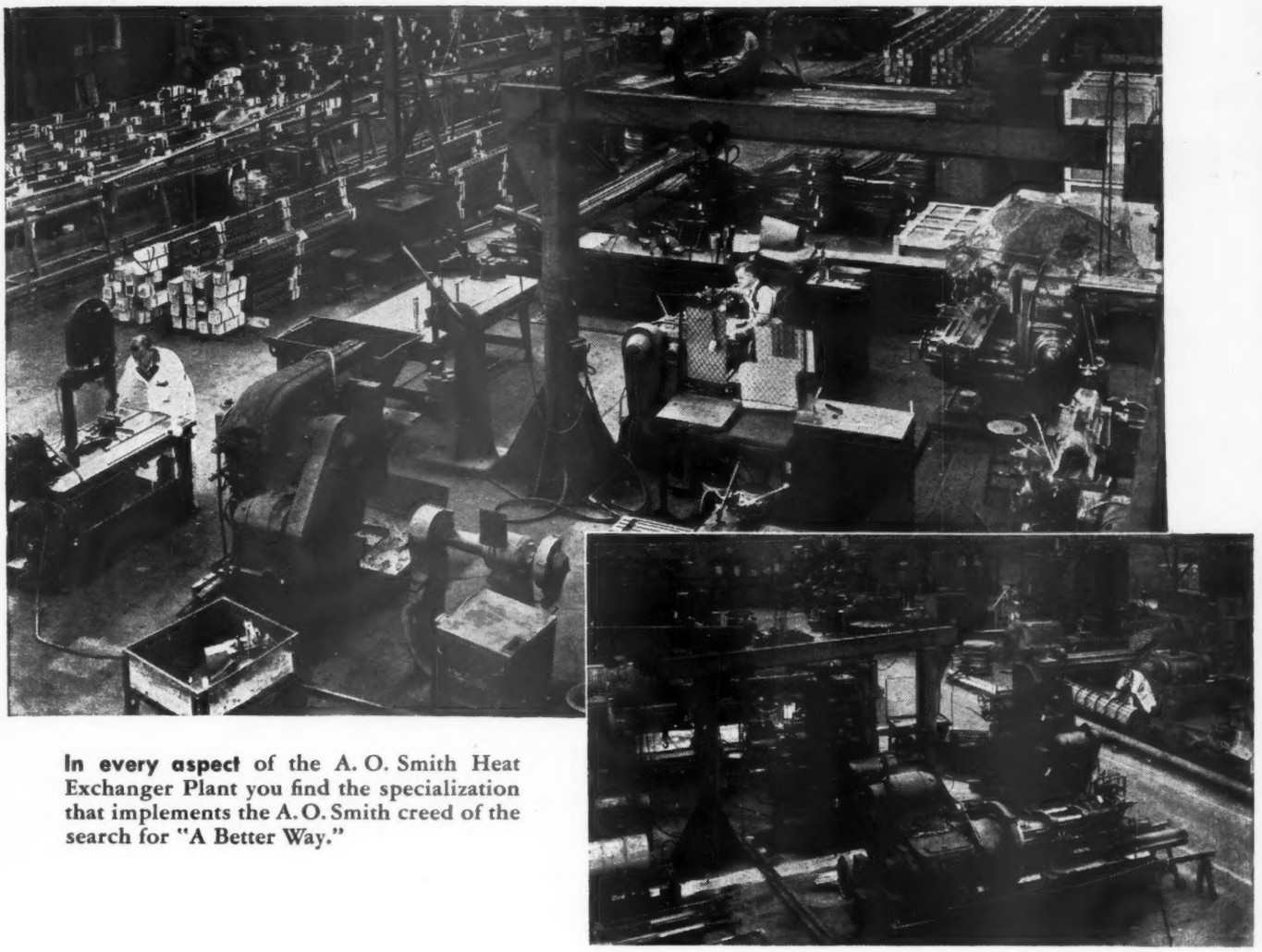
Also out there carving a tortuous route back to the Clubhouse was Dick Morrison, The Texas Company p.a. from New York and about as well known and well liked as any man in the industry. Dick took to the game of golf mostly because he loves the open country which helps to explain why he usually opens it as he goes along. By the way, representing Pittsburgh in this mass assault on the good earth was Charlie Hapgood, the youthful looking manager of tubular goods sales for Jones and Laughlin Steel. We understand he is now working on the perfection of a recording device that will show the exact force with which the face of the club strikes the ball—when the face of the club strikes the ball.

Playing with Fred Currie was a substantial out-of-towner, Ben Gross, president of the Key Company of East St. Louis, Illinois, a practitioner of the Caledonian pastime who apparently is in it for the fun and is not too terribly familiar with such oddities as double eagles. It has always astonished Ben that when a group of golfers are in the shower at the same time, it is utterly impossible to tell whether they are being scalded to death or are just singing.

YALE GRAD BACKS THE IRISH

With one of our favorite people, Jim MacDonald, California manager of Chain Belt Company, came his boss from Milwaukee, George B. Flanigan, general sales manager of the organization, and an old Yale grad who, for reasons you'd never suspect, has chosen Notre Dame as his football team. George is a member of the New York Nomads and has more friends than a blonde coed with a 1951 Cadillac. We asked him if he thought golfers as a class were bibulous and he answered rather cagily, "Well, yes and no. Some of them go to church and some of them don't." John Seiler, executive vice president of Tube Turns, Louisville, Kentucky, was also present at this terrific social affair. We are told that this gentleman never drinks anything stronger than soda pop—a smart idea! We once had an uncle, Angus McMashie, who was killed by hard drink—a block of ice fell on his head. Diverging again, Hans Ross brought a trio of Baash-Ross guests made up of Frank Bergeron, the export manager from New York, Ed "Cactus" Gerke from Houston, and Inky Wotkyns from Oklahoma City. These lads had at each other in a series of domino games as if they were champs, but a sly gander indicatde to this scribe that the performance was on the spotty side, so we snuck away and left them to their pegging.

(Continued on Page A-18)



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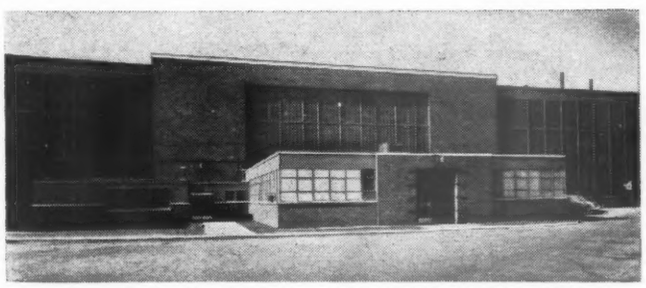

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PERTINENT OPERATING DATA ON UNITIZED OIL FIELDS

	UTAH	WEST VIRGINIA							WYOMING
	Clay Basin	Elk Fork	Shinnston	Shirley	Granny Creek	Rock Creek	Sisterville	St. Marys	Beaver Creek
1	Daggett	Tyler	Harrison	Tyler	Clay	Roane	Tyler	Pleasants	Fremont
2	April 1927	1895	1908	1893	1924	—	1895	1895	June 1938
3	1-1-40	1935	1930	1926	1943	1935	1933	1916	3-29-37
4	Frontier-Dakota	Keener (Big Injun Up)	50′ Sand	Big Injun Sand	Big Injun	Big Injun	Big Injun	Cow Run Sand	Cloverly, Frontier Muddy
5	5500-5800	1,700	2,135	1,900	2,050	2,020	1,600	800	6500-9150
6	Gas	—	—	—	—	—	—	—	—
7	Gas	—	—	—	—	—	—	—	(7 bbl dist/mcf)
8	F-2110, D-2220	—	—	—	—	—	—	—	3,475
9	4,240	2,500	2,450	5,000	—	9,000	25,000	700	4,720
10	11,117	1,900	—	2,700	1,360	850	11,000	435	16,508
11	10	350	—	—	181	—	2,000	133	8
12	10	79	36	78	75	88	385	54	8
13	Gas	—	—	—	—	—	—	—	Gas (with dist.)
14	Gas	—	—	—	—	—	—	—	Gas (with dist.)
15	Mount. Fuel Sup.	—	—	—	—	—	—	—	Stanolind
16	Gas expansion	—	—	—	—	—	—	—	Gas
17	None	Gas	Air-Gas	Gas	Gas	Gas	Gas	Air	None

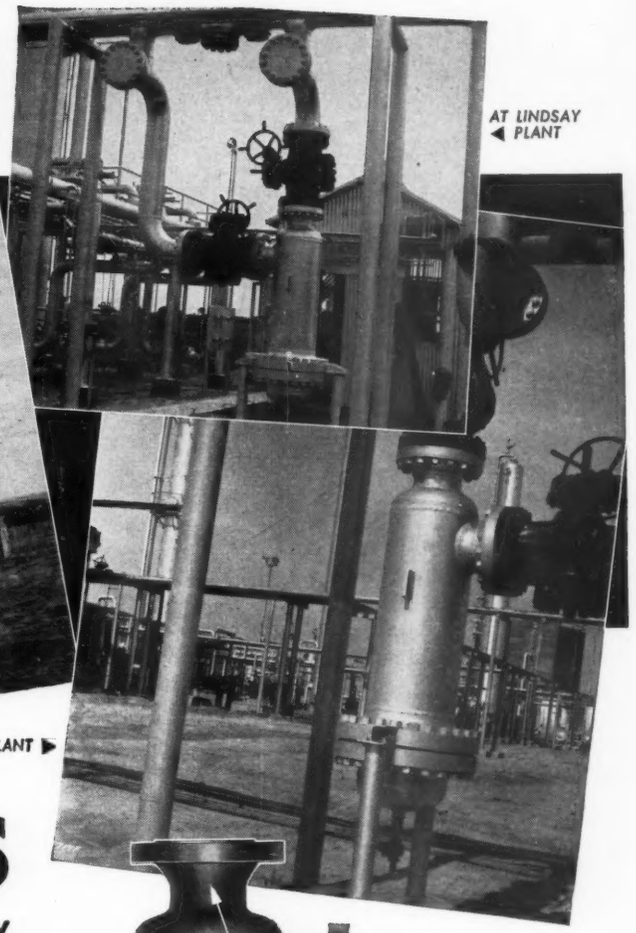
	WYOMING (Continued)								
	Billy Creek	Black Mountain	Cole Creek		Garland		Golden Eagle Dome	Lance Creek	
			(Shannon)	(Dakota-Lakota)	(Utah-So. Unit)	(Kinney Coastal)		(1st Converse)	(1st Sundance)
1	Johnson	Hot Springs	Natrona & Converse	Natrona	Big Horn	Park & Big Horn	Hot Springs	Niobrara	Niobrara
2	1-9-23	November 1923	4-24-40	5-30-38	1929	—	June 1944	—	1930
3	9-15-30	4-1-46	8-3-38	8-3-38	1935	1936	6-25-46	1-1-38	1-1-38
4	Wall Creek	Embar-Tensleep-Madison	Shannon Sand	Dakota-Lakota	Embar-Tensleep-Madison	Embar-Tensleep	Muddy & Lakota Sandstone	1st Converse Sand	1st Sundance Sand
5	3000-3200	3225-3860	4450-4625	7900-8000	—	4000-4500	M-6794, L-7165	4,500	3,700
6	Gas	22.5-26	36-37	32-36	19-25	22-25	M-63, L-55	42	—
7	Gas	—	—	—	—	27	M-6400, L-1250	—	—
8	1,100	—	1,640	3,400	E: T-1360, M-1840	1,360	M-3017, L-2893	—	—
9	710	400	1,652	622.5	—	—	480	285	455
10	710	2,353	18,695	18,695	1,703	1,149	2,039	285	455
11	4	7	29 (max)	6	62	38	2	5	10
12	4	7	26 (pres)	6	21	19	2	5	10
13	Gas	1	—	—	—	—	—	—	—
14	Gas	1	9.9	4.65	—	—	—	—	—
15	—	—	Sole Oper.	Sole Oper.	Utah-Southern	Kinney Coastal	—	Orig. Owners	Orig. Owners
16	—	Water drive	Water, feeble drive	Water, feeble drive	Gas expansion & water drive	Gas expansion & water drive	—	Water drive	Int. Gas Drive
17	Now used for gas storage	None	Water inject 2/46	None	None	None	None	None	Gas

	WYOMING (Continued)								
	Lance Creek—Continued		Little Buffalo Basin		Pitchfork	Salt Creek	South Baxter Basin	Worland	Alkali Butte
	(W. Basal Sund.)	(W. Leo)	(Deep Sand Unit)	(Frontier Gas)					
1	Niobrara	Niobrara	Park & Hot Springs	Park & Hot Springs	Park	Natrona	Sweetwater	Washakie	Fremont
2	March 1935	May 1937	June 1944	1914	1930	August 1917	August 1922	6-2-46	1931
3	1-1-38	1-1-38	5-12-43	12-3-30	1-1-32	1-10-39	11-1-42	8-1-45	10-1-36
4	Basal Sundance Sand	Leo Sand	Tensleep-Embar	Frontier	Tensleep	1 & 2 Wall Creek, Lak, 2&3 Sund, Tens.	Frontier-Dakota	Embar	Morrison
5	4,000	5,000	4,500	1,800	3,900	WC-1300; Tens 3800-4000	2600, 2800	9,970	4,250
6	47.5	42	20.4	Gas	18	38	Gas	35-46	—
7	610	510	20	Gas	(Low)	166 (in 1937)	Gas	—	—
8	1,500Ⓔ	2,050	1,710	477Ⓔ	—	1,000	F-735, D-780	—	1,775
9	1,755	3,020	T-1392, E-1523	4,806	120	15,330	8,366	—	—
10	1,715	2,440	17,651	4,806	2,564	15,440	38,767	22,190	5,639
11	56	112	21	7	3	1,785	25	5	3
12	54	78	18	7	3	16 Tens. (Lt. Oil: 998+168 input)	25	5	3
13	—	—	—	Gas	—	218.2 (2nd Wall	Gas	—	Gas
14	—	—	—	Gas	—	264.0 Crk.)	Gas	—	Gas
15	Orig. Owners	Orig. Owners	Stanolind	Stanolind	Husky Mfg. Co.	Midwest Oil Co. & Mount. Prod. Corp.	—	Pure & Pac. West	Texas Co., et al
16	Int. gas drive	Water drive	Water drive	(Volumetric)	Gas expansion & water drive	W.C.—Volumetric; Others—water dr.	Gas expansion & water drive	Reservoir energy	—
17	Gas	Gas	None	None	None	Gas injection	None	—	—

Ⓔ–Estimated.

Source: Unitization Survey, Research and Coordinating Committee, Interstate Oil Compact Commission.

AT MAYSVILLE PLANT



AT LINDSAY PLANT

AT ANTIOCH PLANT

Staynew FILTERS

in the New Garvin County Plants Protect Compressors, Prevent Injection Well Plugging!

Here, in one of the newest and largest operations of its kind in the entire world, Staynew Filters provide all-important protection for equipment and processing.

In each plant, a Staynew Model HPH Filter removes aluminum oxide generated in the dehydration process from approximately 40 million cu. ft. of gas per day. This aluminum oxide, in the form of an abrasive powder, would cause serious damage if allowed to pass steadily into the lines and equipment which subsequently handle the gas.

In the Antioch Plant, where dehydrated gas is re-pressured to 2400 lbs. and injected into the reservoir, the Staynew Filter not only positively protects the 3 extra re-pressuring compressors against excessive wear, but prevents the pores of the oil-bearing sand from becoming plugged with aluminum oxide.

All Plants Operate Night and Day the Year Around

Such continuous operation would ordinarily require dual installations. However, due to the exclusive Staynew design, a *single filter* only was required at each plant. A by-pass is provided for use during the time required for cleaning or replacement of inserts. Experience indicates that such servicing is not necessary oftener than twice a year, and that only two hours is required for the operation!

This group of filters represents only one of the thousands of Staynew installations in critical service throughout industry. As a result of the many problems solved during these installations, an unsurpassed fund of information in this specialized field has been acquired. For help in solving *your* filtration problems, contact your Dollinger representative, or write direct, care of Dollinger Testing Laboratory.

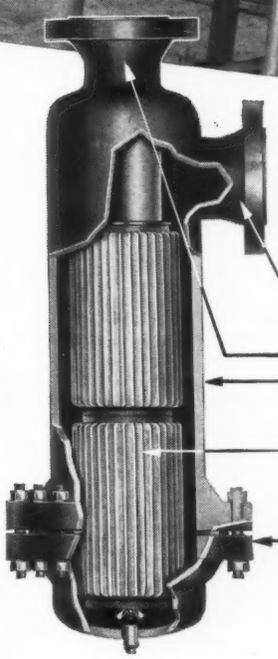


Diagram and Specifications of STAYNEW FILTERS in Service at Garvin County Plants

- Inlet.
- Outlet.
- Forged steel shell, ⅞ in. thickness, certified for 800 lbs. pressure.
- Radial Fin Filter Inserts. Removable by simply unscrewing wingbolt after unbolting head.
- Bolted Head, 32 in. x 3½ in. flanges.

Wt. 3425 lbs.

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DOLLINGER REG. PROTECTOMOTOR U.S. PAT. OFF. STAYNEW FILTERS

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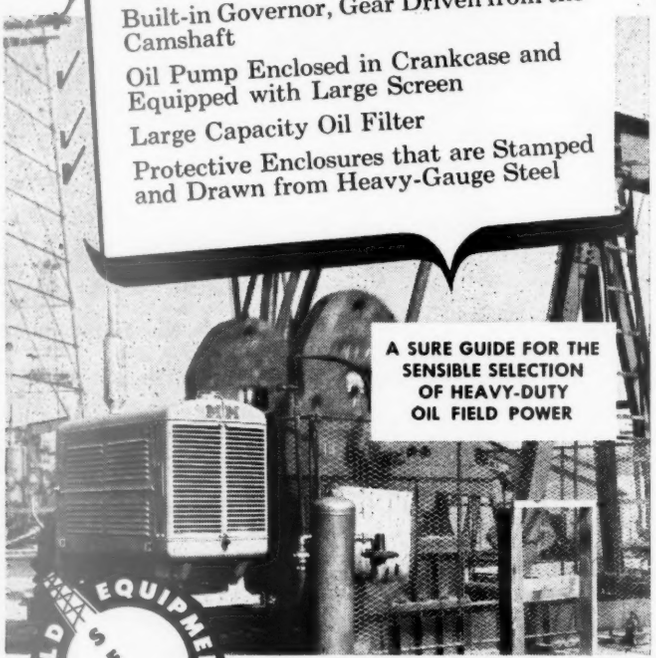
CHECK POINTS FOR LONG ENGINE LIFE

Vital Points in MM Power That Reduce Operating Failures

- MM High Torque is Obtained at Moderate Speeds
- Positive Vacuum Crankcase Ventilation
- Original MM Heat Exchanger Base Pan
- Ignition Cut-Outs on Oil Pressure and Water Pump
- Removable Cylinder Blocks Have Large Water Jackets
- Extra-Heavy Crankcase Sections Provide Maximum Bearing Support
- Rigid Cast Front and Rear Legs That Are Bolted to Crankcase
- Large Twin-Disc Over-Center Type Clutch
- Heavy-Duty Power Take-Off with High-Grade Anti-Friction Pilot Bearings
- Extra-Large Capacity Radiator with Lead-Coated Core and Cast Tanks
- Fan Mounted on Timken Bearings
- Gear-Driven Water Pump with Bronze Impeller and Improved Seal
- Built-in Governor, Gear Driven from the Camshaft
- Oil Pump Enclosed in Crankcase and Equipped with Large Screen
- Large Capacity Oil Filter
- Protective Enclosures that are Stamped and Drawn from Heavy-Gauge Steel



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Petrolic Personalities — Continued

AU REVOIR TO THE BIG SHOT

Wherewith for the moment we leave Bill Farrar, the top Nineteener, and all his aiders abettors. It was a really grand assembly of really grand people and we certainly derived a generous hunk of personal pleasure out of meeting the guests we have attempted to introduce here. We have probably overlooked a few—we usually do—but if so, we'll try to make amends later. Meantime, to Big Shot Bill our congratulations on the outstanding success of his first meeting and best wishes for a lot of luck from here on.

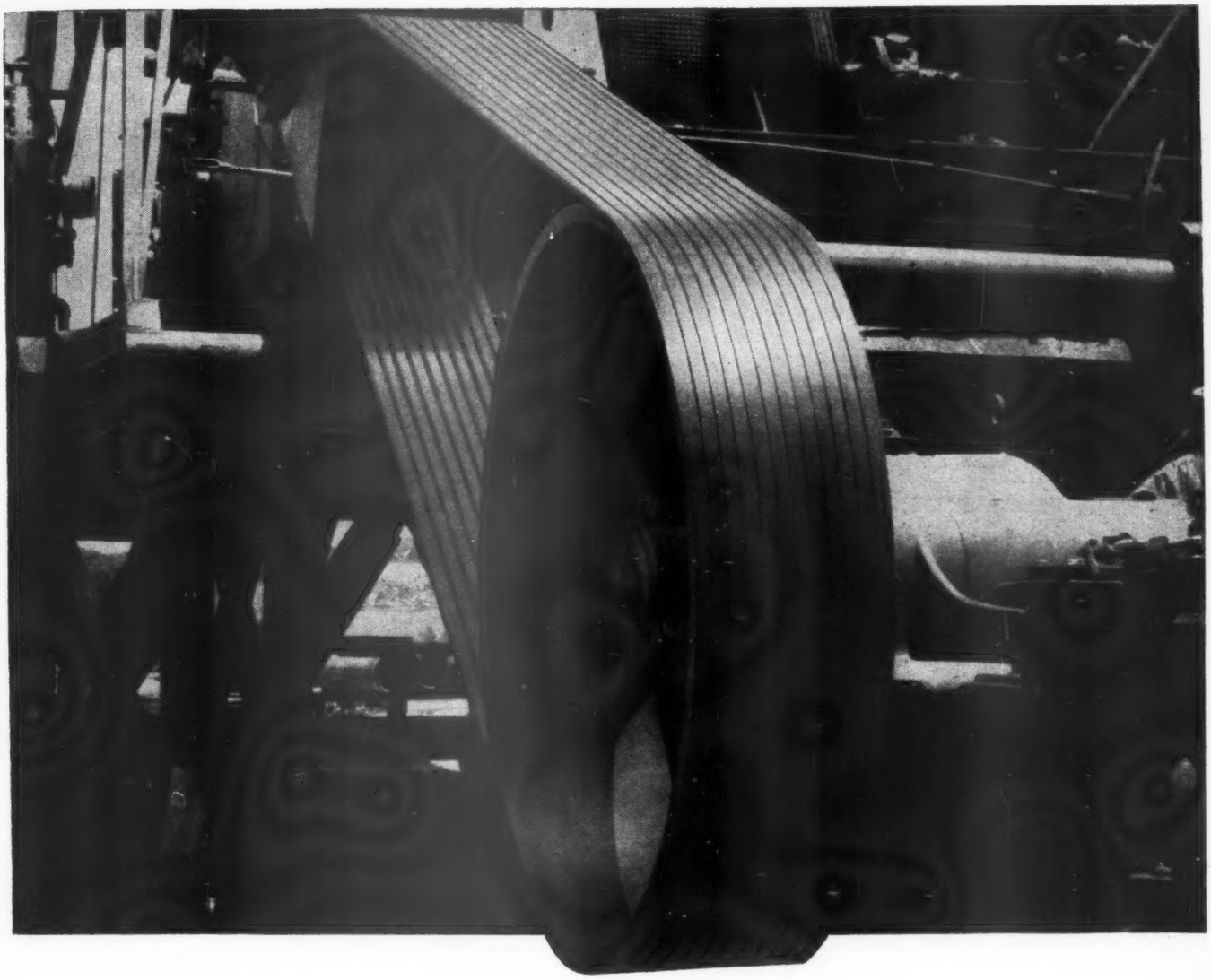
LATE SPORTS NEWS

Not too long ago we had the pleasure of a chat with A. F. "Hoopie" Driskill, drilling superintendent for Iraq Petroleum Company, and bless our soul if we didn't forget to ask him the most important question of all, the sixty-four dollar one, namely, where did that name Hoopie come from? Hoopie was out here when we met him, partly on business and partly on pleasure. He is a native of Spanish Fort, Texas, and began his oil career with the Red River Oil Company in 1913 around the Healdton area. Following a spell in the army during the first war he returned to Burkburnett and Ranger fields, did some drilling in Duncan, Oklahoma, and Mexia, Texas, and then made his way to California where he worked for the Getty interests, George F. and Paul, and for the Standard of California. In 1927 he went to Iraq for the then Turkish, now Iraq Petroleum Company, later became drilling superintendent, and is still a consequential attache of this organization, now situated in London, England, at the headquarters office, and commuting between there and Iraq as the occasion demands. His spare time interest is hunting which he tells us is exceptionally good in Iraq, there being a plentitude of such fine game as black partridge, *chikor* (a sort of mountain pheasant), gazelle, and wild hogs. When not engaged in the pursuit of one or other of these elusive specimens, he takes great joy in ministering to the needs of a lovely little daughter named Phyllis on whom it is rather easy to see he dotes quite a bit more than somewhat.

WEIGHT INDICATORS AND SWORDFISH STEAKS

We traveled with the Editor-in-Chief, Ken Sclater, to Long Beach recently and there had a very pleasant visit with Elmer Decker, the big weight indicator man and world traveler. We found him comfortably ensconced in a thoroughly modern new office with its various vulnerable appurtenances, such as heaters, coolers, utility outlets and inlets, all lofted toward the ceiling. Being in a zone that is subject to occasional flood tides Elmer is making sure that come the next rise he is going to be comfortable until the water reaches well above his head. We examined the effective sound-proofing and attractive decoration in the new quarters and later had an interesting tour of the plant under Elmer's personal guidance. All of this we appreciated and enjoyed no end, also a fine swordfish steak at Welch's cafe where we are told the fish are required to present their birth certificates before being acceptable. The Welch chefs just simply won't consort with any but the young and tender in consequence of which they serve some 600 pounds of swordfish a week.

Incidentally, we might just remark in closing that Donna Decker, the younger daughter of the Decker family and a very beautiful girl has just been chosen to ride on the Long Beach float in the Pasadena Rose Parade on New Year's Day.



BULL DOG V-BELTS ARE THEIR OWN BEST SALESMEN

. . . they resist cracking and deterioration under severe flexing!

If you are less than happy with your V-Belt performance and life — install a set of BULL DOG V-BELTS. THEY WILL SELL THEMSELVES TO YOU! *They are processed for longer life* of completely new compounds under the closest quality controls. Result: Users everywhere are benefiting by cooler running V-Belts which resist cracking and deterioration under severe flexing.

You'll find other good reasons why Bull Dog V-Belts are paying off — (1) in the *high tensile strength* of the exclusive Bull Dog Cord Section which can take heavy loads and absorb severe shock loads . . . (2) in their low stretch due to a new technique of processing Bull Dog Cords which assures minimum slippage and adjustments . . . (3) in their tough, *extra-wear-resistant* covers of bias-cut heavy fabric which seal the belt against the penetration of grease, moisture, dirt.

Back of these better-built Bull Dog V-Belts is the BWH good name — a name renowned for quality mechanical rubber products for 72 years. There's a BWH distributor in your territory. Call him today.

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LETTERS *to the* EDITORS

Approves Hawkins Article

To The Petroleum Engineer:

I enjoyed reading the article on Cooperative Oil and Gas Operations, by Mr. Walace Hawkins in the November issue.

It is a pity that anything having as much merit as unit operation has, should get off to such a bad start as it has in Oklahoma, under their Compulsory Unit Operation Law.

More people thinking and writing like Mr. Hawkins will help.

J. A. Holland

Ordway, Colorado

Annual Index

To The Petroleum Engineer:

Our company receives monthly copies of your publication, The Petroleum Engineer, and these are widely circulated and read, and a good deal of valuable information has been gleaned from them for our various departments.

Until the present the copies have been filed here in the Laboratory, but have not been indexed, or any special items noted. I have now been requested to establish, from all these back issues, a reference library, with a complete index of each magazine.

I am wondering if your company publishes an annual index to your magazine, if so, would it be possible to obtain copies of this index for about the past five years. If such an index was sent with the magazines, it has been lost in circulating the magazines. If there is any charge in connection with obtaining any such indexes, please advise.

Mrs. Jean B. Knott

Madison Natural Gas Company, Ltd.,
Turner Valley, Alberta, Canada

Editor's Note: The Annual Index of The Petroleum Engineer is now published soon after first of year.

Deep Well Data

To The Petroleum Engineer:

Please send us reprints from The Petroleum Engineer of articles on *Deep Drilling Wells* or "Wells Drilled Below 12,000 Feet" in 1948, 1949 and 1950, for our library files.

If there are any charges please send a statement and remittance will follow.

Mrs. V. C. Sanders

Librarian,
The California Company,
New Orleans, Louisiana

Editor's Note: We have a few more of these reprints available without charge.

Home Again

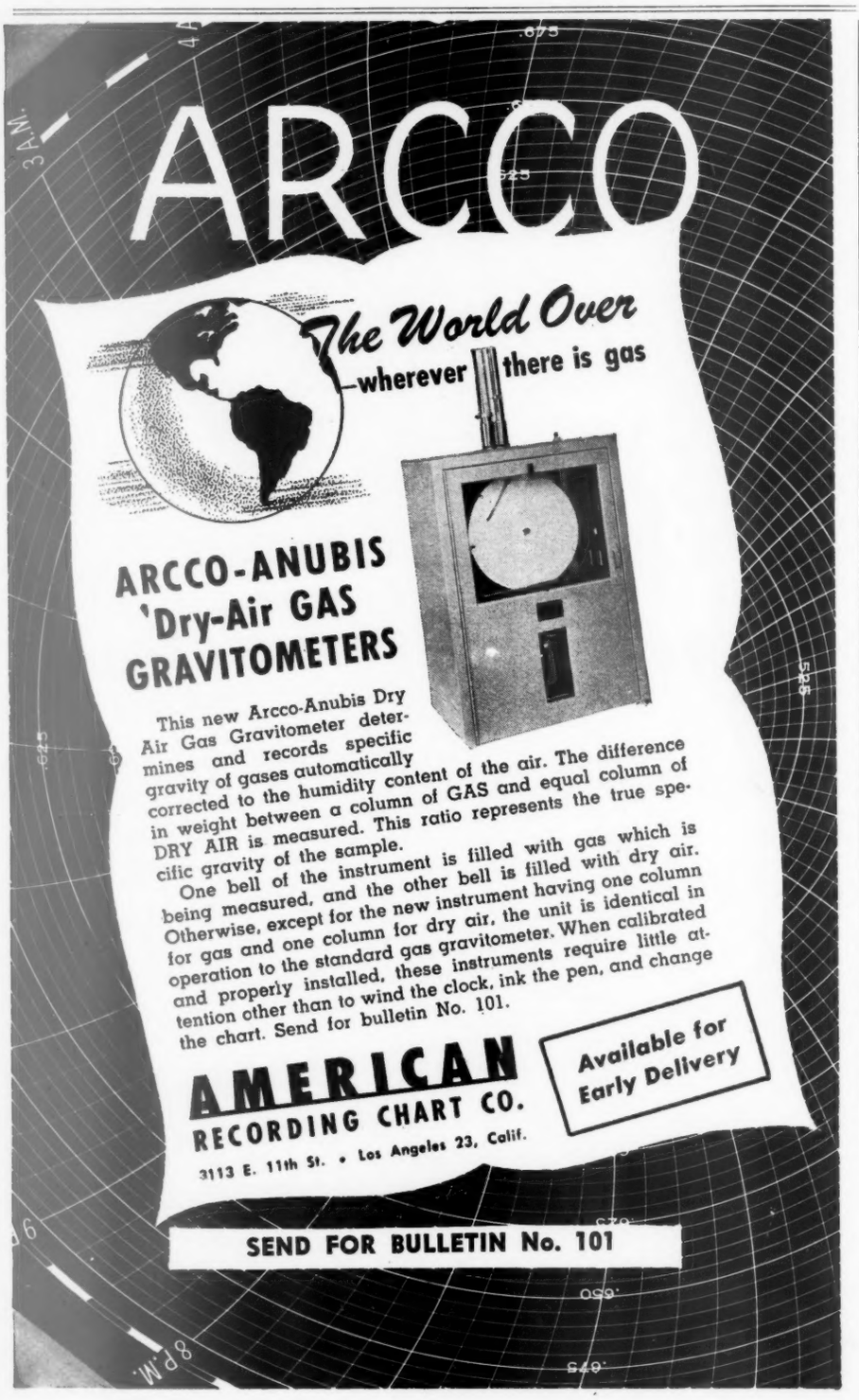
To The Petroleum Engineer:

I have been reading The Petroleum Engineer for the past two years in Venezuela, S. A. I especially enjoyed the interesting up to the minute info of what's new in the field.

Since completing the construction of the Sinclair Refinery at Puerto La Cruz, I have returned to our New York office and would like to continue receiving *The Petroleum Engineer*. Therefore, will you please sign me up for the 3-year subscription.

L. R. Kashdan

Frederick Snare Corporation,
Contracting Engineers,
New York, New York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This new Arcco-Anubis Dry Air Gas Gravitometer determines and records specific gravity of gases automatically corrected to the humidity content of the air. The difference in weight between a column of GAS and equal column of DRY AIR is measured. This ratio represents the true specific gravity of the sample.
One bell of the instrument is filled with gas which is being measured, and the other bell is filled with dry air. Otherwise, except for the new instrument having one column for gas and one column for dry air, the unit is identical in operation to the standard gas gravitometer. When calibrated and properly installed, these instruments require little attention other than to wind the clock, ink the pen, and change the chart. Send for bulletin No. 101.
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THE Petroleum Engineer

JANUARY, 1951
Volume 23
No. 1

An Accurate Method for Determining Average Temperatures in Storage Tanks

A fresh approach to temperature measurement has resulted in development of a new averaging resistance thermometer.

JOHN H. BERGLUND and RAYMOND T. PIERCE

BULK receipts and deliveries of petroleum and petroleum products are generally calculated to the volume occupied at the standard temperature of 60 F. Therefore, it is necessary to determine the average temperature of the product each time a tank is gaged. The cup case type of mercury thermometer is probably the most commonly used instrument for this purpose and the method prescribed in API Code 25 (which parallels the recently adopted ASTM designation D-1086-50T) has been a standard referee method in the petroleum industry for many years. The arithmetical average of cup case thermometer readings taken at several levels is generally accepted as the *average* temperature of the product in the tank. For large tanks containing more than 15 ft of oil, the usual levels specified for temperature determination are "three feet from top surface, middle of oil and three feet from the bottom." The code specifies a thermometer immersion time of "not less than 5 minutes."

Experience has shown that immersion periods of as much as 45 min at each level may be necessary to obtain correct temperatures, particularly in the case of heated stocks, and therefore a gager must spend an average of 20 min to 2 hours on top of a tank in order to obtain a proper average oil temperature. Considering adverse weather conditions, pressure of other operations, etc., the procedure is somewhat impractical. The use of "short cuts" may result in errors. To illustrate the importance of accurate temperature determination, it must be realized that in a shipment of 50,000 bbl of aviation gasoline from an 80,000-bbl storage tank, a 5 degree error in average temperature of the product can result in a difference of approximately 175 bbl (35 bbl per degree) whereas an error of 1/8 in. in gage is only about 17 bbl.

As accurate temperatures are so important, it is apparent that the industry has need for an improved method for determining temperatures that is less time consuming and reduces the possibility of human error.

Historical Background

The initial discussions between representatives of the Standard Inspection Laboratory (Standard Oil Development Company) and the Weston Electrical Instrument Corporation with regard to the problem of measuring bulk oil temperatures occurred in 1944. After a careful review of the problems involved and a study of various methods of temperature measurement, it was agreed that the resistance thermometer had considerable merit and a preliminary field test was proposed.

A portable unit was assembled for trial, and although it was used successfully at that time in both tank car and marine operations, it was not considered to be satisfactory for routine field use because the instrument required careful voltage adjustment and control in order to obtain accurate temperature determinations. Subsequent improvements to the instrument eliminated this objection and plans were made for making a trial installation in a refinery storage tank. A conventional cone-roof tank in heavy fuel oil service was selected for the test and the trial assembly was installed in December 1948.

This device consisted of eight "spot" temperature resistance bulbs mounted at right angles every 4 ft along a vertical pipe situated under the gaging hatch. A common lead

EXCLUSIVE

The Authors

John H. Berglund

John H. Berglund is special technical assistant to the laboratory director of the Standard Inspection Laboratory, Standard Oil Development Company. He became associated with the company as a chemist in 1935 after receiving his BS degree from Wagner College. He has made many contributions to the activities of American Petroleum Institute and American Society for Testing Materials committees on measurement and sampling. Other activities include problems on analytical test methods and marine gas and safety work. He is a member of the American Chemical Society and is vice chairman of the Marine Gas Chemists' Association.

Raymond T. Pierce

Raymond T. Pierce is sales manager of the thermometry and control division of the Weston Electrical Instrument Corporation whose large plant is in Newark, New Jersey. After receiving his BS degree in electrical engineering at University of Maine, he became instrument design engineer for Westinghouse. He has served on the AIEE Instruments and Measurements Committee, and is a member of the Instrument Society of America. Since 1929, when he joined Weston, he has functioned as application engineer, market analyst, and division sales manager.

from all bulbs and a single lead from each bulb came out the top of the pipe. A dial switch for selecting the desired resistance bulb, and one of the improved type of meters calibrated for a temperature range of 60 to 180 F, were mounted on a box on the top of the tank.

"Spot" temperature readings as indicated by the resistance thermometer were taken daily for several weeks. At the same time, temperatures at the location of each resistance bulb were determined with carefully calibrated mercury cup case thermometers. The cup case thermometers were left in each position for at least 30 minutes in order to obtain greater accuracy.

After studying the data, it was noted that the temperatures obtained with the resistance thermometer differed slightly from those obtained with mercury cup case thermometers, and that each difference appeared to be a fixed error for each bulb position. The resistance bulb assembly was removed from the tank and was checked completely in the laboratory for accuracy. It was found that the fixed errors were due to the variations in the resistances of the lead wires connected to the bulbs. Corrections for lead resistance were applied and it was found that the maximum variation from true temperature at the working range was 0.3 F, and the average variation from true temperature was less than 0.1 F.

It was concluded that the connections should be modified to provide a third lead for each bulb that would apply the control voltage at the bulb itself and would place each of the other two leads in opposite arms of the resistance net work. This effectively compensates for variations in lead resistance and it was decided to use this three-wire connection on all future installations.

Although this device indicated "spot" temperatures at fixed levels in the tank with better than the required accuracy, it was suggested that consideration be given to the development of an assembly that would measure accurately the *average* temperature in one reading. Several methods and assemblies were developed and one was selected for trial that seemed to meet the accuracy requirements and could be installed without taking the tank out of service.

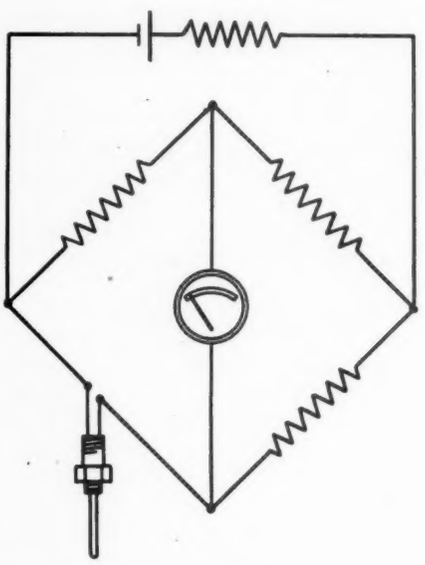


FIG. 1. Wiring diagram.

Electrical Resistance Thermometers

Certain metals, such as copper, nickel, silver, and platinum have the property of changing their electrical resistance uniformly with changes in temperature and, because of the stability of their temperature coefficients of resistance, may be used to measure temperature. The maximum temperature limits for sustained accuracy are about 300 F for copper resistors, 500 F for nickel, and 1500 F for platinum. If the resistor is properly treated the temperature coefficient of resistance remains constant provided these maximum limits are not exceeded.

A resistance thermometer consists of one or more metal resistors connected to a meter assembly made up of a Wheatstone Bridge resistance network, a voltage supply, and a ratio type instrument calibrated in temperature units, °F or °C. The bridge is made up of three units of fixed resistance, each having a zero temperature coefficient, and a resistance bulb, placed where temperature measurement is desired and connected to it as the fourth unit (Fig. 1).

The instrument measures the ratio of the control voltage to the unbalanced voltage of the bridge caused by a change in resistance of the bulb due to temperature. Before World War II, this unbalance was measured by an ordinary millivoltmeter connected across the bridge and the control voltage had to be kept constant in order to obtain accurate results. Weston developed the ratio type meter during the war and the improved instrument eliminated errors caused by changes in control voltage and increased the

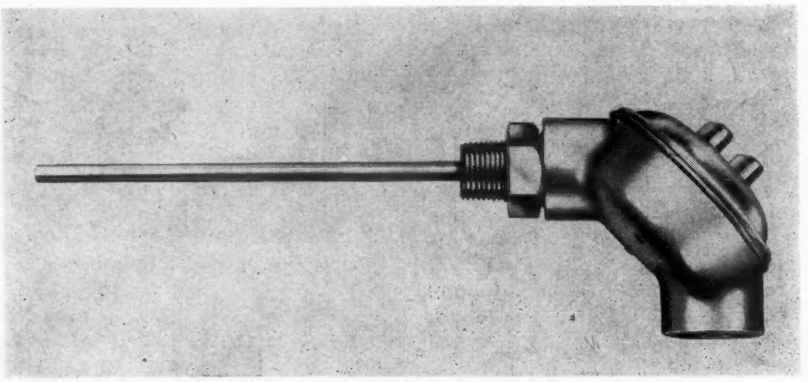


FIG. 2. Tubular type resistance bulb.

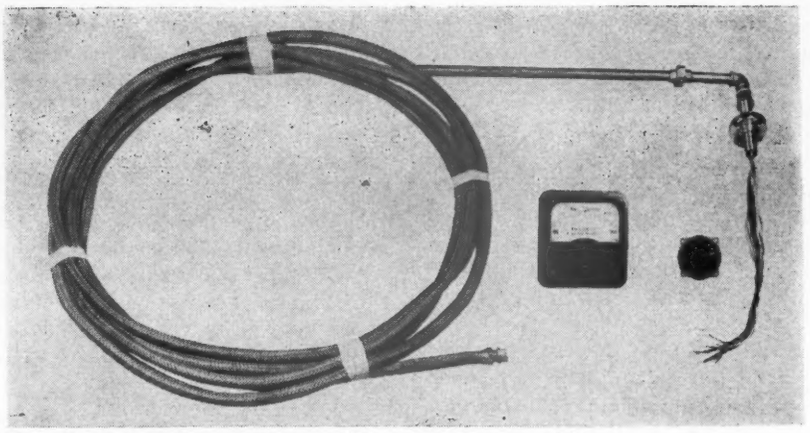


FIG. 3. Averaging resistance thermometer assembly.

accuracy and usefulness of the resistance thermometer. It will indicate correctly regardless of changes in control voltage. There are no control springs.

Resistance bulbs are made in several forms. The tubular type bulb (Fig. 2) consists of a monel or stainless steel tube that houses the resistance element and has a connection nut for mounting. This type is suitable for industrial applications such as obtaining "spot" temperatures in storage tanks or pipe lines.

The averaging type bulb (Fig. 3) consists of an assembly of helically wound copper wire resistance units, each contained in a sealed plastic tube. These resistors are of various lengths (Fig. 4), each having a resistance of 100 ohms at 25 C evenly distributed over its entire length. The resistance units are assembled in cable form and inserted in a ½-in. wire braided flexible metal (bronze) hose to form the "bulb." The tank assemblies described herein consist of 9 averaging type resistors of various lengths from 4 to 36 ft (in steps of 4 ft) so that the full height of the tank is covered. This type of assembly was developed so that the average temperature through a vertical column of oil could be obtained in one reading, thus eliminating the necessity of obtaining and averaging several "spot" temperatures in order to obtain the average temperature of the product in a tank.

The plastic tubing used in the present averaging type bulb limits the use of this design to temperatures below 250-275 F, but materials of greater heat resistance are being tested so that this limit may be increased if required. The accuracy of the instrument is about plus or minus ½ per cent of the scale range and for this reason it is desirable to limit the working range of each meter to not more than 125 deg. A scale range of 0 to 120 F is currently recommended for use with non-heated stocks and 60 to 180 F for heated products. If a wider range is required, the meter can be made with two or more scales in sequence, with a selector switch on the meter box for selecting the desired scale.

The assembly operates on 6 volts d-c which may be supplied by dry cells or from a 115 volt a-c circuit by equipping the meter with a transformer and rectifier. When dry cells are used to supply this voltage they have practically "shelf life".

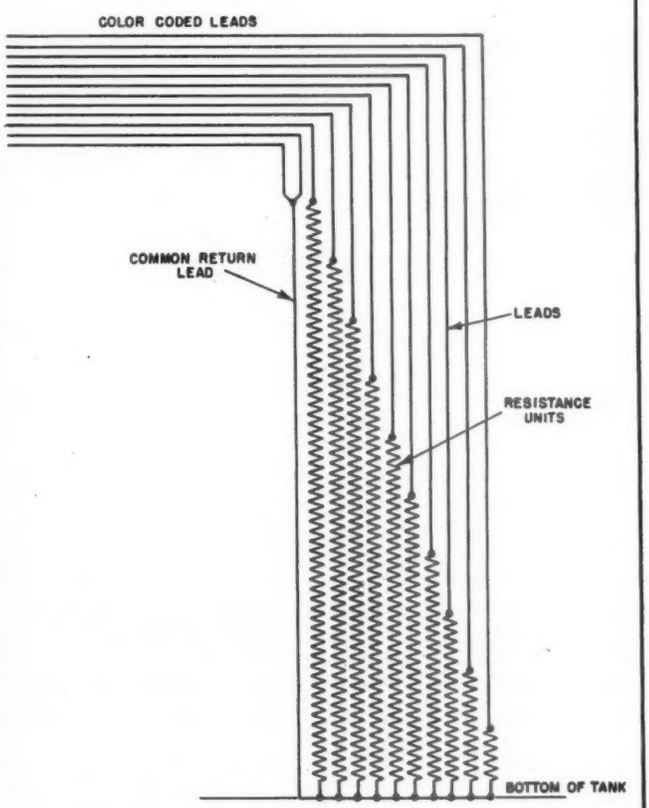


FIG. 4. Schematic diagram of averaging type resistance bulb.

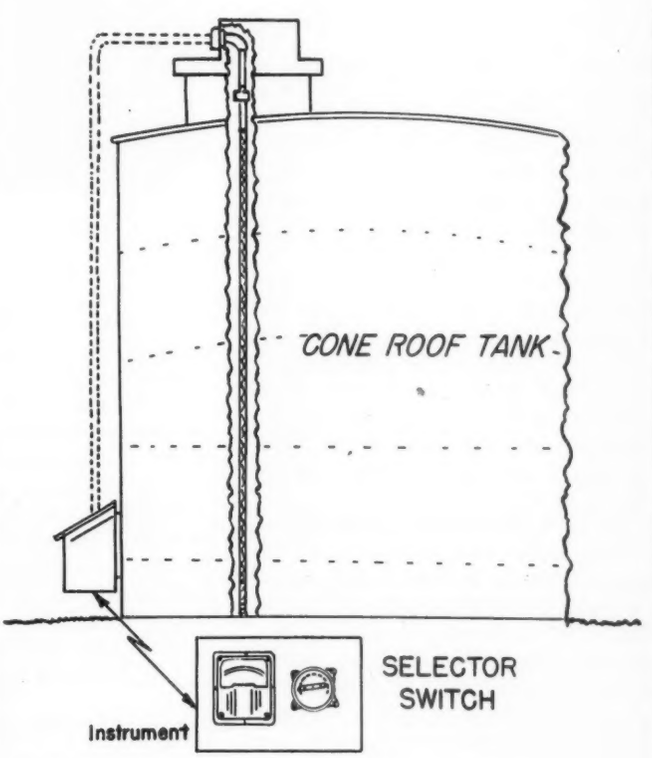


FIG. 5. Conventional cone roof tank installation.

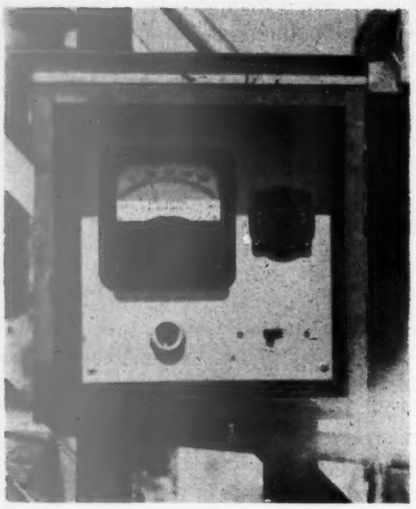


FIG. 6. Meter housing.

Average Temperature Assembly Cone Roof Tank

a. **Description of installation.** The first installation of the average temperature assembly was made on a conventional cone-roof tank in heavy fuel oil service. The averaging bulb contained 9 resistance units, each being a multiple length of 4 ft so that product levels from 4 to 36 ft were covered for temperature determination. The flexible bulb was suspended vertically inside the tank and passed through a flange in the tank roof (Fig. 5). The resistance units were connected to a selector switch marked in feet of oil level, and to a meter, both placed in a weather-proof housing at the foot of the stairway (Fig. 6). The assembly operated on 6 volts d-c supplied by batteries. The meter (Fig. 7) was calibrated in degrees F with a scale range of plus 60 to plus 180 F. The assembly was operated by setting the selector switch pointer at the proper position (according to the product level in the tank so that the longest completely submerged resistance unit was connected to the meter) and turning on the current. The average temperature of the product in the tank was indicated on the meter scale.

b. **Field test procedure.** As the purpose of the test was to check the accuracy of the averaging resistance thermometer it was necessary to determine the true average temperature of the product in the tank.

Two cup case thermometers that conformed with ASTM specification 59F-48T were selected and standardized against basic standards at the Standard Inspection Laboratory and were found to have an accuracy within plus or minus ½ F. Initial tests showed that it was sometimes necessary to leave these thermometers suspended in the oil for a period of 45 min or more in order to obtain the correct temperature. In addition it was found that the average of top, middle, and bottom temperatures did not always check the average temperature indicated by the resistance thermometer.

This initial test work resulted in two additional problems:

1. To explain the seemingly excessive immersion time required for mercury cup case thermometers.
2. To determine the true vertical temperature gradient of the oil by a rapid and accurate method. (The use of the cup case thermometers would not be practicable because of the excessive immersion time required.)

A test was made at the Standard Inspection Laboratory that indicated that the required immersion time for cup case thermometers may be a function of the oil viscosity. Two 4-ounce bottles were filled three-fourths full with heavy fuel oil and Standard ASTM 59 F thermometers were inserted through cork stoppers into the body of the oil. The bottles were immersed in a thermostatically controlled water bath maintained at 100 F and the time required for the thermometers to indicate the bath temperature was recorded. Next the bottles were transferred to a second bath at 130 F and then to a third at 160 F. When the thermometers indicated 160 F, the procedure was reversed by placing them back in the 130 F bath, then 100 F, and back to room temperature. Results were as shown below:

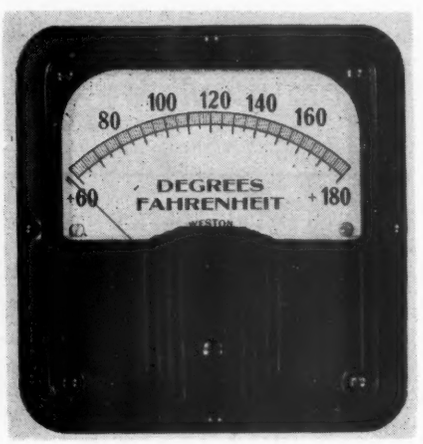


FIG. 7. Meter.

The results indicated that the heat transfer through viscous products was very slow and therefore it was decided that an immersion time of 45 min should be allowed for all cup case thermometer readings taken during the field test.

It is obvious that the cup case thermometer results obtained and reported with the field test data are more accurate than would have been obtained under normal operating procedure in which the immersion period is generally 20 min or less.

As a solution to problem 2, a portable resistance thermometer was assembled. This instrument consisted of a single tubular type bulb attached to a 50 ft cable and connected to a meter in a portable case (Fig. 8). The assembly was carefully calibrated to an accuracy of plus or minus ¼ F against the standardized ASTM 59 F thermometers. This instrument permitted determination of "spot" temperatures at any level in the tank by lowering the tubular type bulb to the desired position. Response was a matter of a few seconds as compared with 45 min per "spot" for the cup case thermometer. The true temperature gradient of the product was obtained by taking "spot" temperatures every 18 in. vertically throughout the depth of product.

In order to nullify the errors that might occur due to variations in the resistance of the lead wires, three wires were used to connect the resistance units of the bulb to the instrument. This enabled the voltage to be applied at the resistor itself by placing one lead in one arm of the bridge circuit and the other in the resistor arm. As these leads were in cable form, changes would be the same on each side but would be nullified as far as any effect on the reading was concerned. An instrument having a range of plus 60 to plus 180 F was used.

c. **Results.** Tests were conducted over a period of several weeks during which time there were variations in oil level, outside temperature, and product temperature. The curves shown in Figs. 9 and 10 are typical of the results obtained.

Fig. 9 shows the temperature gradient as obtained with the portable standard resistance thermometer with 9½ ft of fuel oil in the tank. The average of the readings was 94.2 F.

Thermometer	Room Temp. (76.5 F) to 100 F	100 to 130 F	130 to 160 F
No. 1	65 min	50 min	50 min
No. 2	53 min	55 min	50 min
Thermometer	**160 to 130 F**	**130 to 100 F**	**100 F to Room Temp. (81 F)**
No. 1	25 min	50 min	90 min
No. 2	25 min	50 min	90 min

FIG. 8. Portable standard resistance thermometer.

In computing this average, the readings obtained at the bottom of the tank and at the surface of the product were omitted. In the averaging resistance thermometer assembly, the 8-ft resistance unit was the longest that was completely submerged. This was connected to the meter by manipulating the dial switch and an average temperature reading of 94.25 F was obtained. API Code 25 specifies a middle oil temperature only for product levels of less than 10 ft. The cup case thermometer was lowered to the mid-point and left suspended for 45 min. A reading of 99.0 F was obtained, which differed from the "true average" by approximately 5 deg.

Fig. 10 shows the temperature condition existing with 28½ ft of oil in the tank. This curve was plotted from data obtained with the portable standard resistance thermometer and the average of these readings was 91.3 F. The 28-ft resistance unit in the averaging thermometer assembly was the longest unit that was completely submerged. When connected to the meter by means of the dial switch, an average temperature reading of 91.25 F was obtained. The average of the cup case thermometer readings obtained at each of three levels, as specified in API Code 25, was 90.7 F. A 45-min immersion time was allowed for each reading.

Average Temperature Assembly Floating Roof Tanks

a. **Description of installation.** A second installation was made on a pontoon-type floating-roof tank in gasoline service. The thermometer assembly used in this installation was the same as that previously described for the cone roof tank except that the meter had a scale range of minus 20 to plus 120 F. The flexible bulb was suspended vertically from a support connected to the tank shell so that it was in line with and passed through the gaging hatch on the floating roof (Fig. 11). In order to accomplish this, the hatch cover was altered by cutting two holes and welding two short pieces of 1½-in and 3-in pipe, respectively, to it. The bulb passed through the 1½-in opening, which had been fitted with a plastic bushing so that the roof could rise and fall without snagging (Fig. 12). The selector switch, meter, and batteries were placed in a weather-proof housing at the foot of the stairway.

b. **Field test procedure.** The procedure followed was identical with that used in testing the cone-roof tank assembly. It was noted that the temperature of the product in the gage pipe that passed through the pontoons might be quite different from the temperature of the product in the body of the tank and the condition varied depending on outside temperature and whether the sun was shining on the roof. The gage pipe contained about 2 ft of product and although the temperature of this amount had considerable influence over the vertical average temperature, it was completely out of proportion to the amount of oil in the tank. Therefore, it was decided that the average temperatures of the product as determined with both the averaging resistance thermometer and the portable standard should be based only on product temperatures determined below the underside of the pontoon.

c. **Results.** Two curves are shown that are typical of the results obtained during the test.

Fig. 13 shows the temperature gradient with 18½ ft of gasoline in the tank on a cloudy day. This curve was plotted from data obtained with the portable standard resistance thermometer and the average of the readings was 52.75 F (omitting bottom and gage pipe temperatures). The longest resistance unit, completely submerged but not extending into the gage pipe, was 16 ft and an average temperature reading of 53 F was obtained when connected to the meter. The average of three thermometer readings, obtained at each of three levels, was 52.8 F. A 45-min immersion time was allowed for each reading.

Fig. 14 shows the temperature gradient with 12¼ ft of gasoline in the tank with sun on the roof. The data were obtained using the portable standard resistance thermometer and the average of the readings was 49.4 F. The 8 ft resistance unit was selected as the longest completely submerged unit not extending into the gage pipe. When connected to the meter an average temperature reading of 49.5 F was obtained. API Code 25 specifies the averaging of two cup case thermometer readings and, after 45 min immersion at each location, an average of 50.0 F was obtained.

Installation Features

The mechanical design of the averaging resistance thermometer permits installation of the assembly without taking the tank out of service. The instrument is rugged and the electrical energy is so small that it is well below arcing values. This meets general safety requirements.

The assembly may be checked in the field by making the following observations:

a. A reading of 70 F on the scale, when the selector switch is turned to the "TEST" position, indicates that the meter and batteries are in good

California Gasoline Tax

Gross gasoline taxes assessed by California for September amounted to $13,223,502 on a taxable distribution of 293,855,596 gal of gasoline and liquefied petroleum gas. This was an increase of about 9,000,000 gal or 3 per cent over the September 1949 volume. An additional 2,199,475 gal of LPG were sold tax free.

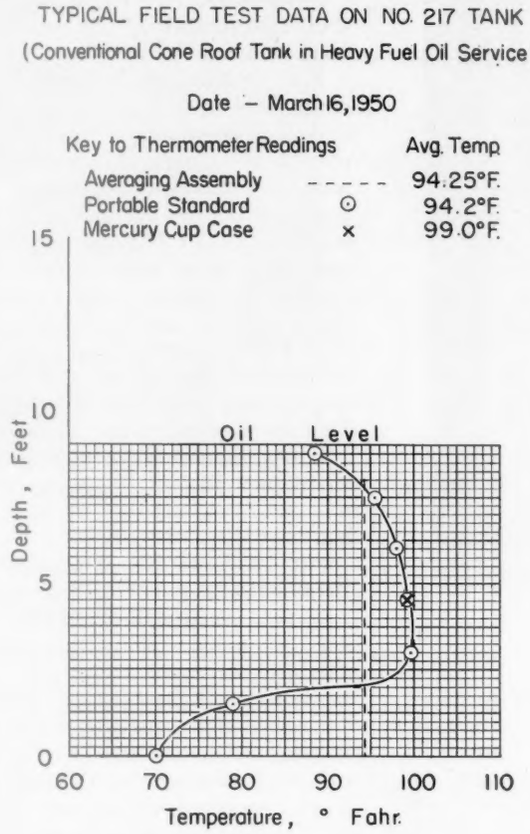


FIG. 9. Typical field test curve—cone roof tank, March 16, 1950.

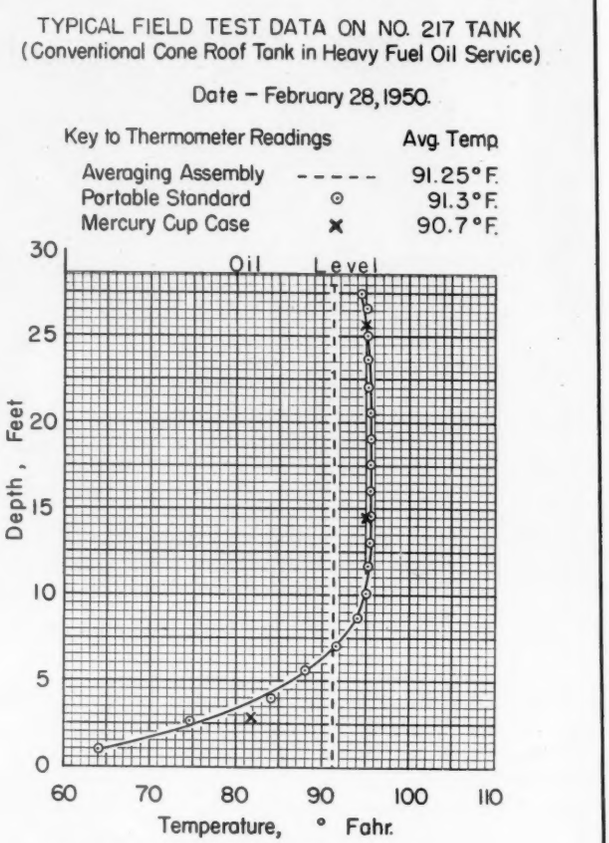


FIG. 10. Typical field test curve—cone roof tank, February 28, 1950.

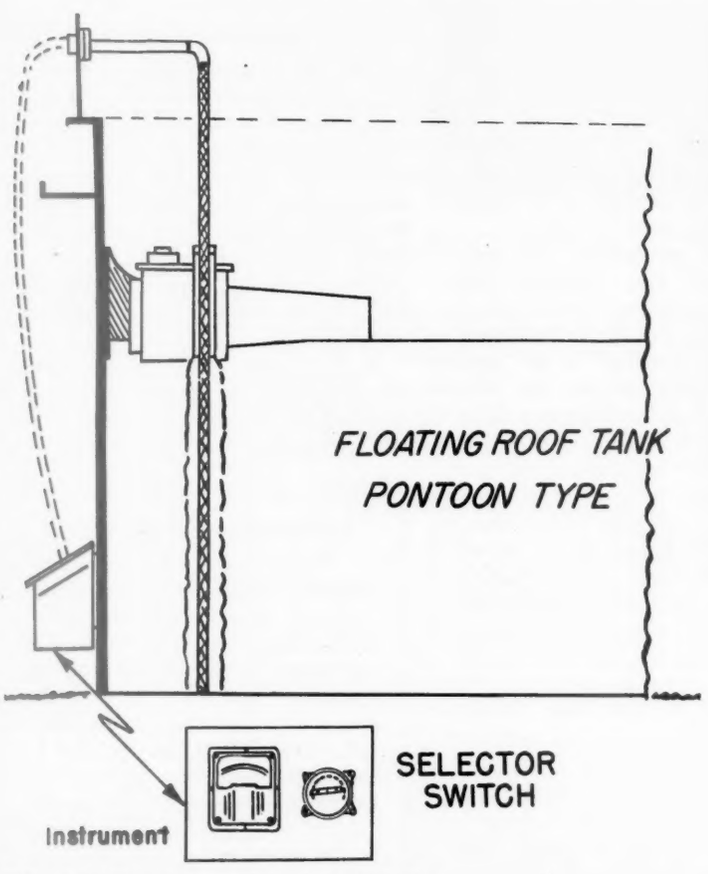
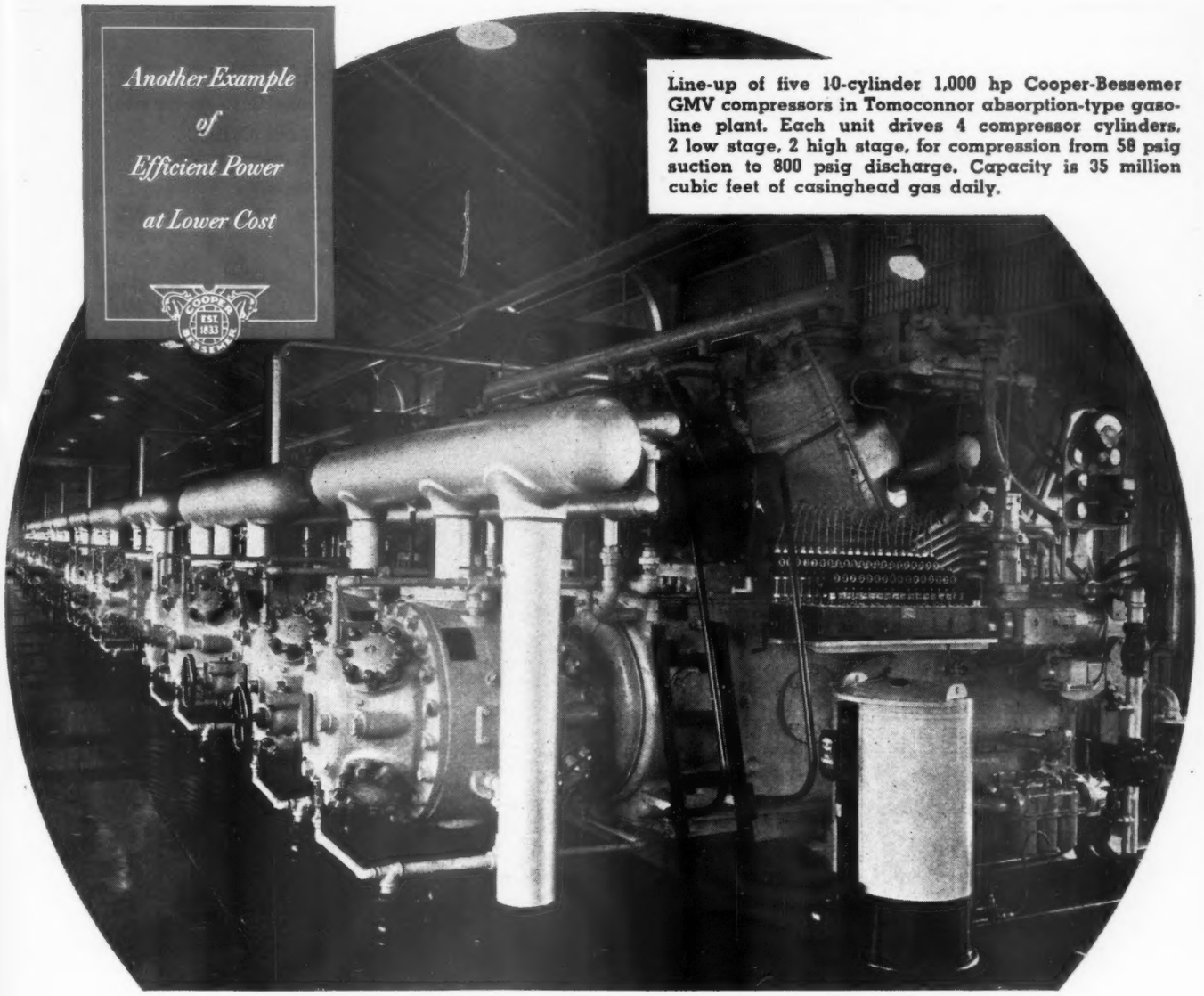


FIG. 11. Floating roof tank installation.

FIG. 12. Gage hatch alteration.

Another Example of Efficient Power at Lower Cost



Line-up of five 10-cylinder 1,000 hp Cooper-Bessemer GMV compressors in Tomoconnor absorption-type gasoline plant. Each unit drives 4 compressor cylinders, 2 low stage, 2 high stage, for compression from 58 psig suction to 800 psig discharge. Capacity is 35 million cubic feet of casinghead gas daily.

Line-up of GMVs at Tomoconnor helps line up profits in gas conservation

The Tomoconnor gasoline plant on the Texas Gulf coast is known for its high recovery of hydrocarbons and for unusual economy and efficiency of operation.

Naturally, compressor performance is a mighty important cog in the efficient, low-cost operation of this or any gasoline plant. Here, five 1,000 hp Cooper-Bessemer GMVs, as always, bring a number of significant advantages . . . exceptional compactness for cost savings in housing and installation, month after month of trouble-free, on-stream service, and the kind of over-all operating and maintenance economy that does your heart good.

We could go on and on about the features and advantages that are paying off in GMV-equipped plants. Maybe you have compressor needs coming up. If so, get *all* the facts . . . on GMVs or on our other modern V-angle type compressors . . . 200 to 2,400 bhp.

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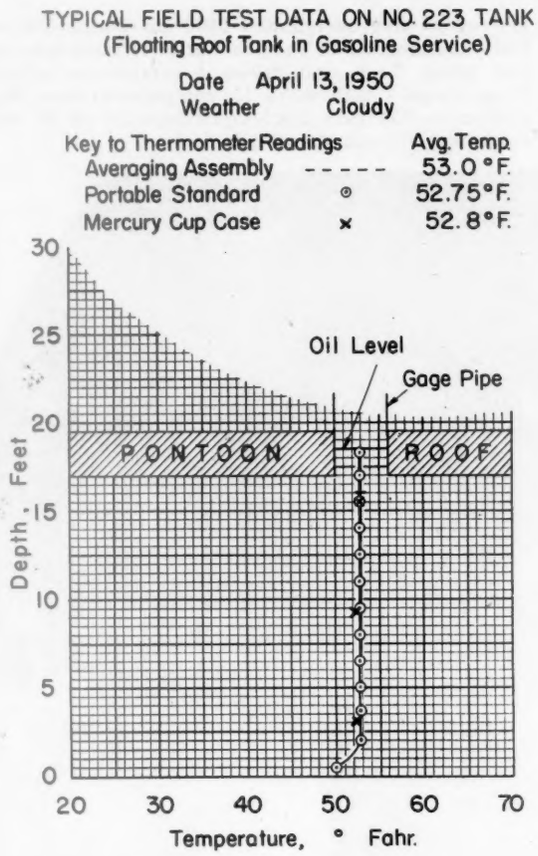


FIG. 13. Typical field test curve. Floating roof tank, April 13, 1950.

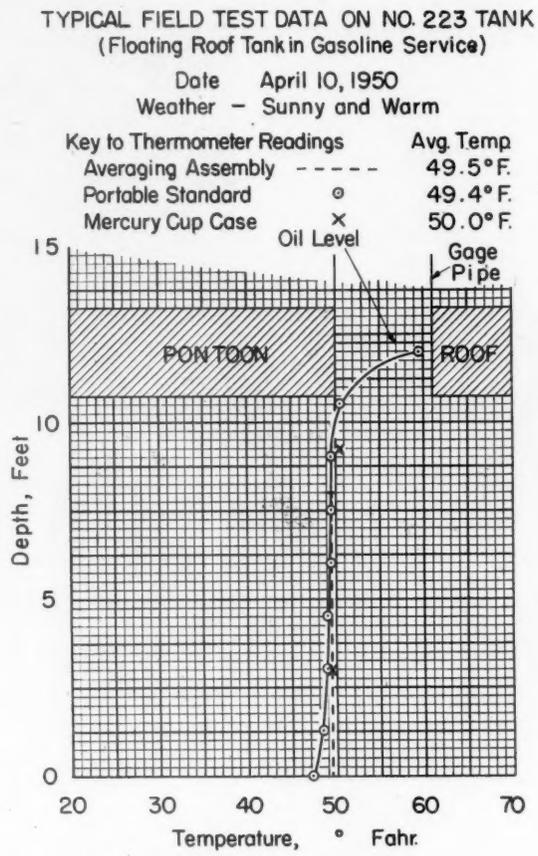


FIG. 14. Typical field test curve. Floating roof tank, April 10, 1950.

condition. A standard resistor is included in the assembly for this check operation.

b. Slow response in the meter indicates low battery voltage. Low voltage does not affect the accuracy of the instrument.

c. An "off scale" reading on the high side indicates an open circuit on a resistance unit.

d. An "off scale" reading on the low side indicates a short circuit on a resistance unit.

Pipe Line Temperatures

At the same time the field tests were being conducted on the averaging resistance thermometers, a trial installation of tubular type resistance bulbs was made to measure the temperature in pipe lines delivering product to a tank truck loading rack.

Loading rack line temperatures are generally obtained by mounting either mercury-in-glass angle stem thermometers or dial thermometers at points in the pipe where they can be read by the attendant. This means that the location has to be such that the thermometers are accessible for reading and may not be the best location for getting good product temperatures. Also, thermometers so placed are subject to breakage, become dirty, and are difficult to read.

A tubular type resistance bulb was mounted in each pipe riser at the rack and leads were run to a bulb selector switch and meter situated at the rack office. By means of the selector switch the attendant could select the resistance bulb in the active line and read the temperature without leaving his office.

It was found that temperature readings were taken more often during loading and a procedure has been worked out, for stock control purposes, for quickly obtaining an usuable average temperature of the product delivered.

Conclusions

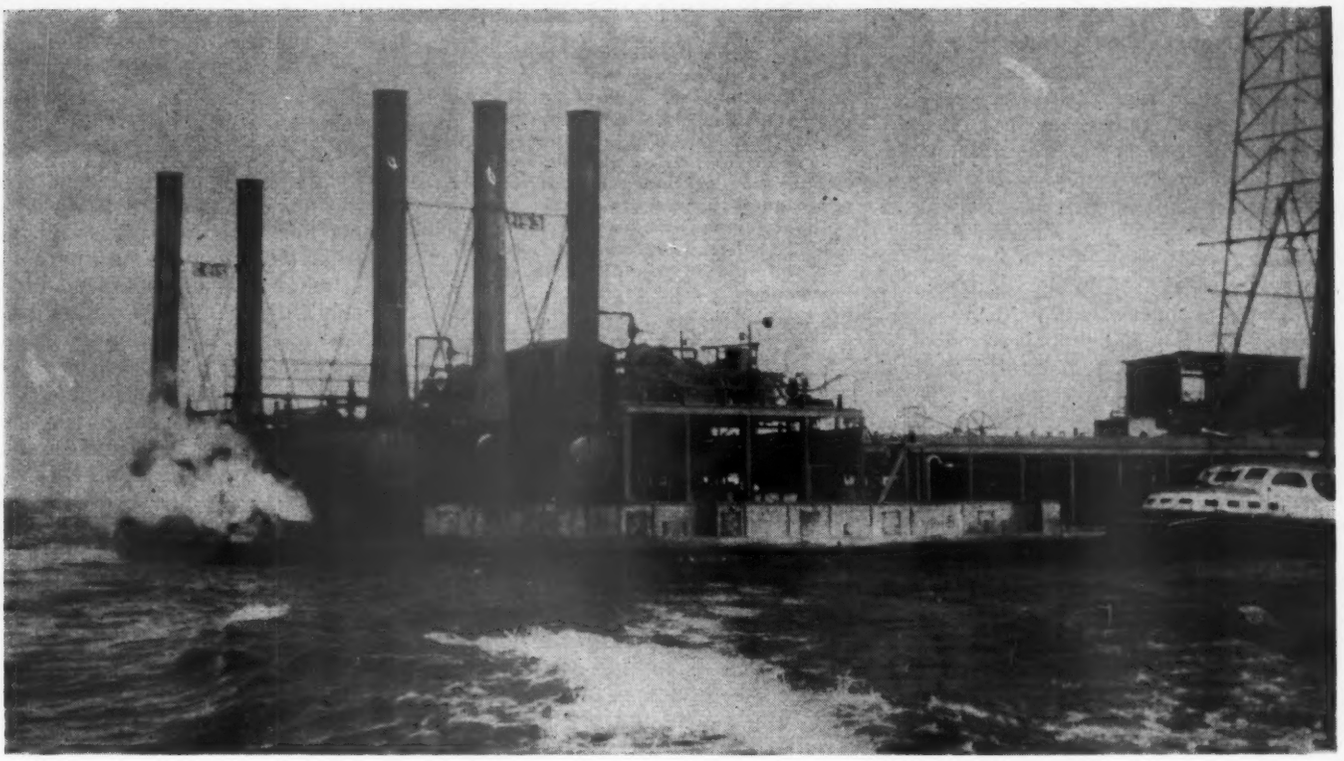
1. Temperature readings can be obtained with the averaging resistance thermometer in a few seconds as compared to 20 minutes to 2 hr total necessary immersion time for cup case thermometers. This wide variation in time is influenced by the type of product, its temperature, and the amount of product in the tank.

2. Accurate average temperatures are indicated with the resistance thermometer regardless of the temperature gradient of the product in the tank. Under some operational conditions with heated stock, errors as high as 5 F were noted when using cup case thermometers although a much longer immersion time was allowed for each reading than is the usual practice.

3. The averaging resistance thermometer offers much better operational control, particularly under adverse weather conditions and when making a number of consecutive deliveries of small quantities. The meter is usually situated at the foot of the tank stairway so that readings can be obtained from ground level. If desired, however, it can be placed at a remote point such as a pump house or superintendent's office.

4. The possibilities of errors due to the human element are greatly reduced because of the simplicity and ease of operating the resistance thermometer.

* * *



Barge used in drilling operations on Lake Maracaibo, Venezuela.

Outlook for Latin American Oil Development

LESTER C. UREN

FUTURE development of the petroleum industry in Mexico and the countries of South America and the commercial control and distribution of petroleum industry products from this region should be of paramount interest and importance to American oil companies. Latin America is one of the world's few remaining petroleum industry frontiers offering promise of substantial reserves of petroleum conveniently accessible to United States markets. The countries south of the Rio Grande River may afford an opportunity for investment of American venture capital. Control of surplus petroleum industry products entering international trade from these countries promises to be important in supplementing U. S. domestic production, particularly under war-time conditions when supplies of oil from more remote areas may be difficult or impossible to control. This article offers a brief discussion of the current position and conditions that promise to influence the future development of the petroleum industry in the producing regions of Latin America, and reviews some of the difficulties that must be overcome if American free enterprise is to exert a controlling influence in the commercial exploitation of these resources.

The opportunities presented for participation in the further development of petroleum resources in the Latin American countries are presently overshadowed by more spectacular results currently being obtained in the Near Eastern and Canadian developments, but American companies should not allow the greater profits obtainable from enterprises in these other regions to divert them from continuing cultivation of their Latin American interests. United States investors already have a substantial stake in the Latin American oil industry. The prestige and generally favorable position presently enjoyed by U. S. oil companies in South America could easily be lost by failure to maintain a vigorous policy of continuing support and further development of their holdings in these countries.

EXCLUSIVE

Several different countries have made substantial contributions to the petroleum production of Latin America. Table 1 presents the best available statistics on current rate of production, cumulative production, and apparent prospective reserves for the several countries that have made significant contributions.

Venezuela

Venezuela is the leading Latin American country from the standpoint of past and current production and apparent reserves. For the past several years, it has ranked second among the world's petroleum producing countries and its production is especially significant in international commerce because nearly 90 per cent of it is

available for export. United States and British nationals have largely financed the development of the petroleum industry in this country, which has been under way since 1917.

In 1949 Joseph E. Pogue* estimated that upwards of two billion dollars had been invested in the Venezuelan petroleum industry, almost entirely from foreign sources. The Venezuelan government has pursued a liberal policy in encouraging investment of foreign capital; and though royalties and taxes take about half of oil industry profits, incentives appear to be adequate to maintain a healthy industry. Venezuela's economy is vitally dependent upon employment in and royalties and tax revenue from the petroleum industry. More than two-thirds of the government's budgetary income is derived from this source.

During recent years, about one-third of the country's current petroleum production has been exported to the United States and one-third to British and other European markets. Venezuela has thus enjoyed ample dollar and sterling exchange for support of her imports from these sources, and is presently the only Latin American country in this favorable position. Unfortunately, oil from the Near Eastern fields now threatens to replace a large part of the European market for Venezuelan oil and recent retrenchment of oil industry activity in Venezuela is attributed primarily to this competition. Development of a new iron-ore industry that promises to yield substantial tonnages of high-grade iron ore to U. S. steel mills, may soon provide a new prop to Venezuela's economy.

Venezuela achieved a record production of petroleum in 1948. That of 1949 was only 1½ per cent less. During 1949, it became necessary to curtail production of heavy crude as a result of over-supply, but this trend has now been reversed and war-time conditions in the United States may be expected greatly to stimulate the market for Venezuelan crudes and a new production peak may soon be reached. Venezuelan producers have also been concerned over the threatened increase in duty on crude petroleum imported into the United States, but this threat may also disappear under the impact of war. Easily accessible by low-cost ocean transport, Venezuelan oil is of special significance to United States consumers, particularly in time of war when movement of oil from middle-eastern and far-eastern sources may be cut off.

*Pogue, J. E. "Oil in Venezuela," Chase National Bank Bulletin, 1949, 49 pp, New York.

The author, professor of petroleum engineering, University of California, spent several months in Latin American countries this year. His first-hand account of present activities and his consideration of future possibilities presented here are valuable information for the international oil operator. Few men have such a profound knowledge of the oil industry as Lester Uren.

The very substantial petroleum reserves in this country promise a continuing industry of substantial proportions. The estimated nine-billion barrel reserve in present known fields is about one-tenth of the world's proved reserve, and deeper producing horizons and extensions of present fields and new structures yet to be tested promise additional discoveries. Geological and geophysical work and exploration drilling is active and prospects seem good for development of additional reserves to support an expanding market.

Mexico

Mexico nationalized her petroleum industry in 1938, with expropriation of all foreign-owned properties. Since that time, all petroleum industry activities have been entrusted to the government-sponsored organization, Petroleos Mexicanos ("Pemex"). Mexico's annual rate of production reached its peak in 1921 when the country ranked sixth among the oil-producing countries of the world.

Production quickly declined, however, during later years and in 1949, only 62,000,000 bbl were produced. "Pemex" has been hampered by lack of capital, equipment and machinery, and by difficulties imposed by radical labor unions, and has seemingly been unable to maintain production or find new reserves. The adverse land laws, which prohibit ownership or leasing of oil lands by private owners, has discouraged foreign capital from participation until recently when the Mexican-American Independent Oil Company was organized to assist in exploring for and developing new reserves. This organization of U. S. oil men is in a position to provide capital, equipment, and skilled personnel and has already been successful in discovering a new field near Coatzcoalcos, on the Gulf Coast in the State of Vera Cruz. It is understood that this company will have no land titles or exploitation privileges, but will recoup its costs and take its profits in a royalty on the oil produced from its discoveries. Participation of foreign capital in this way promises to bring renewed life to Mexico's oil industry and perhaps enable her to regain something of her lost prestige.

The reserve of producible petroleum in present known Mexican fields was recently estimated by a prominent "Pemex" official at 1,270,000,000 bbl. It is generally believed, however, that Mexico contains large undiscovered reserves that may be found by a well financed, skillfully directed exploratory program. The country may therefore be expected to better materially its present producing capacity in the years to come.

Mexico's domestic consumption of petroleum products was 44,600,000 bbl in 1949, so that about 17,000,000 bbl was available for export, chiefly to the United States. This exportable surplus of petroleum has been an important factor in Mexico's economy. Her rapidly increasing domestic demand for petroleum products and her need for additional dollar exchange make it imperative that production be increased if possible, and it is hoped that recent field discoveries and the expanded drilling program now under way may make possible a production of 100,000,000 bbl during 1950.

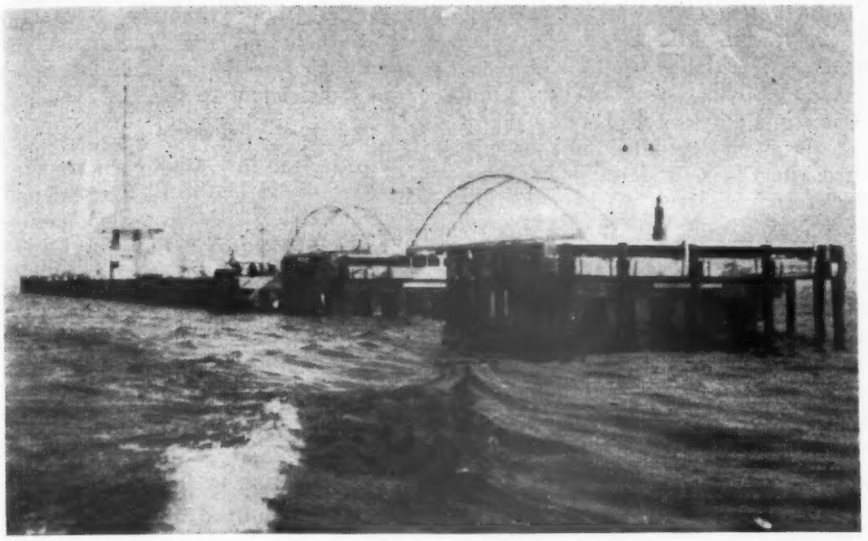
Colombia

Colombia's petroleum production reached an all-time high in 1949 with a production of 29,643,975 bbl, an increase of 24 per cent over 1948. This has been a result of freedom from labor disturbances during the past year and completion of pipe lines affording a larger outlet for production from recently discovered fields. This does not, however, reflect the immediate prospects for the future. During

TABLE 1.—Petroleum production and reserve statistics for various Latin American countries.

Country	Annual production thousands of barrels 1948	1949	Cumulative production to Jan. 1, 1950, thousands of bbl	Apparent reserves, Jan. 1,, 1948* thousands of bbl
Venezuela	488,647	482,165	5,002,000	8,800,000
Mexico	60,736	62,000	2,409,599	1,270,000
Colombia	23,917	29,644	471,002	422,300
Argentina	23,661	23,992	435,147	252,859
Trinidad	20,199	20,617	392,492	208,277
Peru	14,069	14,796	386,483	148,000
Ecuador	2,611	2,615	46,444	21,781
Bolivia	464	678	4,971	58,632
Brazil	143	109	639	2,900
Chile	....	55	55	30,000

* Reserve estimates by G. C. Gester, World Petroleum, November, 1948, page 252, except in the cases of Mexico and Chile.
# Production statistics from Bulletin of the A.A.P.G., July, 1950.



Facilities for loading shallow-draft tankers, Lake Maracaibo.

recent years, seven large oil companies, employing the best technical talent and modern methods and equipment, have conducted exploration campaigns and test drilling in promising areas. Four of these companies have greatly reduced their exploratory efforts during the past year and some are withdrawing from Colombia. Some 15,500,000 acres previously held under various concessions have been relinquished, as well as 2,600,000 acres held under option. One large company that has been active over a period of many years and is continuing its operations, has recently reduced its headquarters staff by more than 50 per cent.

The 1,265,000-acre De Mares concession in the central Magdalena River Valley, which has been exploited by the Tropical Oil Company since 1922, is still the source of about 40 per cent of Colombia's oil. Under the terms of the concession, title will revert to the government in 1951 and preparations are now being made for the change in ownership. It has been estimated that upwards of 100,000,000 bbl of oil still remains in the La Cira and Infantas fields and the surface installations are valued at $15,000,000. Present plans contemplate retention of a 45 per cent interest by the government while majority control and exploitation management will be granted to a new company, which will provide $15,000,000 of new capital to be raised from private sources. In addition, the government will continue to take a 10 per cent royalty on the entire production. While withdrawing from the De Mares concession, the Tropical Oil Company has other interests in the country and plans to retain its marketing outlets. Additional refining and pipe-line projects are in process of construction or are being planned by the government agency in charge of oil industry operations. They promise cheaper and more dependable transportation and increased supplies of refined products and natural gas service in some principal industrial centers.

Colombia's petroleum reserves were estimated in 1947 by one authority at 422,000,000 bbl, but when recent discoveries are more fully developed and other promising areas are tested, it is probable that a much larger reserve will be disclosed. Like Venezuela, Colombia is of international importance because a large part of her production is available for export. In 1945, 86 per cent of her petroleum output entered international trade.

Argentina

Production of petroleum in Argentina in 1949 was at an all-time peak of 23,992,000 bbl. This was only about half of the country's oil needs, the balance being supplied by imports from other countries. The petroleum industry here is already in the hands of the government-owned oil trust, Yacimientos Petroliferos Fiscales. Other private companies that were active before most of the country's potentially productive land was nationalized are still permitted to continue exploitation of previously acquired properties; however, they now represent only a minor segment of the industry. YPF has been active in exploration and development work in the more promising areas, but has been greatly hampered by shortage of supplies and equipment. Some of the drilling operations are being conducted by a U. S. drilling contractor.

Of the several producing regions in Argentina, the Comodoro Rivadavia district is by far the most important from the standpoint of past and current production, and most of the country's available reserves, estimated at 300 million barrels, are here. While the possibly productive areas have by no means been thoroughly explored and additional fields will doubtless be found in future years, the outlook for substantial new reserves is not considered especially promising. Interest has lately focused on the Tierra del Fuego district by the successful development of the Cerro Manantiales field in Chile, but thus far drilling on the Argentine side of the peninsula has only been productive of natural gas which is of little use in this remote region. It is possible, however, that an important supply of natural gas here might ultimately be connected with the recently completed 10-inch 1100-mile gas pipe line which extends from the Comodoro Rivadavia fields to Buenos Aires. This industrially important pipe line will deliver 42,000 MCF daily when all contemplated compressor equipment is installed.

Trinidad

Petroleum production on the Island of Trinidad has been declining from the peak of 25,000,000 bbl per year reached in 1925 and in 1949 was 20,616,721 bbl. The island's 15 oil fields, individually small, are situated in the southwestern portion of the island. Though they have been commercially exploited since 1910, and proved reserves are estimated at only 208,000,000 bbl (1947), exploration is still active. While the area available for future exploration is small, there are possibilities for discovery of additional fields, particularly along the flanks of the central mountain range. The possibilities of deeper producing sands and extensions of present producing areas are also being tested. Marine drilling along the Gulf of Paria is also a future possibility.

British control and customs give the Trinidad industry a somewhat different flavor from that of the nearby mainland of South America where the Latin influence dominates. Though the current production is small when compared with that of Venezuela, it is nevertheless the largest in the British empire and has been actively fostered by the British government. About 70 per cent of the oil produced is available for export, is strategically situated near important shipping lanes and is economically significant in world commerce.

Peru

The Brea-Parinas, Lobitos, and Zorritos oil fields on the peninsula form-

ing the southern shore of the Gulf of Guayaquil in northwestern Peru, though exploited since 1883, still continue to produce substantial volumes of oil. As a result of more intensive development work than usual, production was increased in 1949 to 14,650,000 bbl. About half was available for export.

In 1939 the promising Ganzo Azul field was discovered in eastern Peru, to the east of the Andes mountains. Here several wells are reported to have developed initial productions as high as 1000 bbl per day, but the area is difficult of access and until a market and pipe line outlet are established, this field must be largely shut in. Production in 1949 was 140,000 bbl.

The visible reserve in Peruvian fields was estimated in 1947 to be 148,000,000 bbl, but it is believed that this estimate does not properly reflect the recent developments in eastern Peru where large undeveloped and undiscovered reserves are believed to exist.

Land laws considered prohibitive by private oil producers have caused all foreign companies to withdraw from Peru except those having prior rights not prejudiced by the present laws. A proposed new and somewhat more liberal land law is under consideration. The Peruvian government has established a national petroleum reserve of approximately 8,000,000 acres, including a large, almost uninhabited area in the Oriente (Montana) district near Brazil.

Ecuador

Production in Ecuador has thus far been confined to the El Cautivo and Ancon fields of the Santa Elena peninsula. The 1949 production was 1,859,480 bbl, a slight increase over that of 1948. Reserves are small, estimated in 1947 at only 22,000,000 bbl. Explorations in eastern and northern Ecuador have thus far been unsuccessful. It is reported that the Shell Company, which has been active in eastern Ecuador, has recently withdrawn. Labor and political difficulties, poor transportation facilities, and shortage of supplies and equipment have hampered exploration activities.

Bolivia

Bolivia's petroleum production is as yet small but promises considerable expansion during future years. The Camiri, Sanandita, and Bermejo fields of southern Bolivia, near the borders of Argentina and Paraguay, yielded 578,000 bbl of petroleum in 1949. Three other fields in this same region are regarded as proved and other prospective structures are being tested.

The government oil trust, Yacimientos Petroliferos Fiscales Bolivianos, which has exclusive control of all oil industry activities, has been active in exploration and development work and in the construction of a new refinery and 371 miles of pipe line for crude oil transport, completed and placed in service in 1949. The country is now able to supply its own oil needs with a moderate amount available for export. The United States government assisted the Bolivian Government in financing these operations.

Brazil

Production of petroleum in Brazil has thus far been confined to six small pools in the State of Bahia, near the Atlantic coast. Of these, only four were producing in 1949 when they yielded 109,000 bbl. Nowhere else in all the vast territory of Brazil—an area 200,000 square miles greater than that of the United States—is petroleum produced in commercial quantities. Conselho Nacional de Petroleo, the Brazilian government petroleum council, has made a determined effort to find additional sources of supply and has given every encouragement to both public and private agencies but with little success. Meanwhile, other Brazilian industries have been rapidly expanding and oil has to be imported for practically all domestic needs. It is said that most of the Brazilian coffee export is needed to offset imported oil.

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. . . SEALING PRESSURES SINCE 1888 . . .

Some success has been had in the production of oil products from oil shales and bituminous sandstones in the states of Parana and Sao Paulo. As for the future, one must assume that in all the vast sedimentary areas of Brazil, substantial petroleum reserves will eventually be found, but they may lie in the remote and hardly accessible sub-Andean trough in the far-western jungles and their discovery and exploitation may be deferred for many years.

Chile

Chile's first oil field, the Cerro Manantiales or Springhill field of Tierra del Fuego, near the southern end of the continent, was discovered only four years ago. First commercial production was taken in November and December 1949, when 46,000 bbl of oil was moved through a 42-mile pipe line to a marine terminal on the Straits of Magellan, where storage and tanker-loading facilities have been provided. Though production is as yet small the region is regarded as one of considerable promise for future development. Severe climatic conditions will probably hamper operations. The Chilean government hopes that oil from this source may soon supply all domestic needs. The government-owned Corporacion de Fomento de la Produccion has the sole privilege of developing, refining, and marketing the oil from the Magellan industry.

Other countries of South and Central America are not as yet productive of petroleum in commercial amounts. Three relatively small fields have produced small amounts of petroleum on the island of Cuba, but they are not considered to be of commercial importance. Exploration and test drilling has been under way in some areas, notably in Paraguay, near the Bolivian producing fields, and in Panama, but as yet without success.

Future Development

The foregoing sections have been concerned with an appraisal of the present state of development of the petroleum industry in Latin America. We may now consider some of the factors that seem likely to influence future development of the industry in this region.

The "Dollar Shortage"

Perhaps the principal barrier to current industry development is the inability of nearly all the Latin American countries to finance purchase of equipment and materials in the United States. Adverse trade balances with the United States in all countries except Venezuela operate to restrict free purchase of U. S. goods and in most cases the Latin American governments have been compelled to ration dollars available for U. S. purchases. This difficulty has been accentuated by devaluation of most of their currencies, which makes U. S. purchases very costly in comparison with prices prevailing in earlier years.

Latin American countries now find trade with sterling block countries more advantageous, but unfortunately these countries are not in a position to supply much of the specialized equipment and materials needed in oil field operations. In earlier years, Latin American countries were able to finance U. S. purchases by exchanging for dollars European currencies received for goods sold in Europe, but recent restrictions imposed on international exchange by the sterling-block countries now compel unilateral trade.

Though progress is being made in developing heavy manufacturing industries in some South American countries—notably in Argentina and Brazil—these countries are, as yet, dependent on North American and European countries for almost all their iron and steel products and industrial machinery. Except for a few items, most modern oil industry drilling, production, and refining equipment is currently obtainable only from the United States, and control of the necessary dollar exchange is a matter of vital concern in further development of the petroleum industry.

This difficulty can be alleviated by encouraging additional importation of South American products into the United States, by further investment of U. S. private capital in the South American industry, or by credits established through U. S. government or World Bank loans. Unfortunately none of these avenues of relief seems to be presently available. Oil industry venture capital finds more promising and profitable returns from investment in other regions, Canada, for example. U. S. Government agencies are too preoccupied with European and Asiatic financial needs to give consideration to promotion of South American industrial needs, and the United States apparently does not need or want additional South American products. Yet, it would appear desirable, in preserving our present stake and promoting our future position in the South American petroleum industry to find some means of alleviating this situation.

Nationalization

Prevailing land laws throughout Latin America, which derive from the Spanish colonial concepts of land ownership, permit the government to take control of all subsurface minerals, and most of the Latin American republics have exercised this right in positive fashion. In a few countries, notably in Venezuela, Colombia, and Brazil, the governments have adopted systems of administration of their mineral lands that permit private individuals or corporations to obtain leases or concessions in prospective or proved petroleum-bearing areas and to produce and market oil therefrom. In other cases, the governments have preferred to establish government-owned and operated trusts charged with the responsibility of exploiting their petroleum resources. Mexico and Bolivia afford examples of complete nationalization of the petroleum industry, while Argentina and Chile have established government-owned and operated oil companies but still permit a certain degree of competition by private industry.

In general, the Latin American countries appear to be moving toward nationalization of their petroleum industries, a trend that in time may entirely exclude foreign corporations from control of producing and refining properties and even from competition in the marketing of petroleum products. In Argentina, while foreign oil companies are still permitted to remain in possession of their properties if legally acquired in earlier years, and to participate in the domestic market, they are restricted in many ways and the government policy apparently contemplates giving the government-owned Yacimientos Petroliferos Fiscales an eventual monopoly. And in Colombia, Peru, and Chile the more promising prospective areas have been set aside for exploitation by government agencies.

While the Latin American countries apparently desire to exclude or restrict other nationals from control of their petroleum resources, they are in most cases unable to finance an active program of exploration and exploitation and usually lack the equipment and skilled personnel so necessary for successful results. They must depend largely upon foreign sources of capital, equipment, and skilled personnel. The United States is the most likely source of such aid and the Latin American countries are looking hopefully to their nothern neighbor for helpful understanding of their desires and needs. They would prefer direct financial aid from the United States government, but as this is not readily obtainable, are also seeking aid from private investors willing to participate on a minority basis. The Mexican government, for example, has lately been seeking a substantial loan from the United States government for petroleum industry development but has

meanwhile procured assistance from private sources, as explained in an earlier paragraph.

Political Trends

In most of the Latin American countries, political unrest is a deterrent to long-range economic planning. This is not new for through many decades most of the South American governments have been noted for their unstable character. Earlier difficulties stemmed largely from the activities of opposing political personalities, often finding expression in military coups and minor revolutions that were frequently abortive. While they sometimes resulted in overthrow of the existing government, the new government usually had very similar economic objectives and continuity of industry and property rights previously acquired were generally preserved.Today other forms of political change threaten, which if successful may seriously alter the existing economy and make investment of foreign capital in these countries less attractive than in the past.

In some cases the new forces that threaten change may be characterized as radical socialism, with easily led militant labor groups exercising a destructive influence on the economy. And lurking in the shadow of these labor groups are the ever present communists seeking to impose their concept of government. The communist influence is undoubtedly strong in some of the South American countries, sufficiently so to influence elections and choice of executives and legislative bodies. In some countries where such parties have won control of government harshly restrictive, almost confiscatory legislation and heavy taxation have discouraged industrial expansion. The fear that these radical elements may assume control of government has in some countries led to reactionary military dictatorships that continue in power for years with restriction of civil rights. In such a political atmosphere long-range economic planning is impossible and foreign investors are reluctant to risk large investments that require many years of amortization. Only ventures that can pay out in a short time with large profits to offset the political hazards seem attractive.

High Cost

The search for and exploitation of oil fields in Latin American countries is considerably more expensive than in the United States. The regions in which the work must be conducted are often remote and difficult of access and transportation of equipment and products is costly. High and rugged mountains bar the way in some areas; marshy lowlands and jungle conditions in others. Severe climate, tropical diseases, and hostile natives sometimes make operations difficult. Delivery of heavy drilling equipment inland from coastal harbors is hampered by absence of or inadequacy of railroads and highways. River transport is seasonal. In some regions the oil companies have found it necessary to resort to expensive air transport for movement of men and equipment.

Because of distance from supply centers and transportation difficulties oil companies find it necessary to anticipate their equipment needs by many months and carry large stocks of supplies in local warehouses. One company finds its preferable to pay the added cost of rapid air transport for delivery of many supply items than to suffer the interest loss on warehouse inventories and supplies in transit involved in slow ocean, river, rail, and highway transport.

Labor costs are also high in most Latin American countries. Militant labor unions, often supported by pressure from socialistically inclined governments, have forced wage scales and employee welfare plans to cost levels that are becoming a bar to the economic well being and prosperity of the industry. In the Venezuela oil industry, for example, Pogue* recently estimated that direct and indirect compensation averages $15.13 per man per 8-hr working day, the highest oil industry wage in the world. This includes the basic pay, over-time pay, vacation pay, travel time to and from work, medical and hospital service, housing allowance or maintenance, educational facilities, commissary expense, entertainment, profit-sharing, and other items. "Take-home" pay is the equivalent of $9.84 per day. There are only 280 working days in the year; four-week vacations with pay; the work-week is 48-hr and there are no seasonal lay-offs. About 58,000 people, 93 per cent of whom are Venezuelans, are employed in the petroleum industry in this country. Other industries have found it difficult to meet the labor standards set by the oil industry. Agriculture, which is necessarily based on low-cost labor, has particularly suffered by this competition.

Oil companies operating in Latin America find it necessary to make provision for many indirect services not considered a part of the cost of doing business in most regions. They must build roads, develop power plants, water and communication systems; provide schools, workers' housing, stores, recreational, and other camp facilities.

*Pogue, J. E., "Oil in Venezuela," Chase National Bank Bulletin, 1949, 49 pp., New York.

Taxation is pushed to the limit in some Latin American countries, the governments showing a tendency to assess all that the industry can bear. Other restrictions may also be imposed, limiting the oil companies' freedom of action in conducting their business affairs. For example, government exchange controls may hamper the company's ability to import needed equipment or transfer earnings to home offices; or government agencies manned by politicians with little understanding of the petroleum industry and its ways of doing business, may impose burdensome restrictions.

It is reported that because of the high cost of labor, materials, and equipment, operations in Latin American countries cost from two to three times what they would cost under comparable conditions in the United States. Because of the growing cost of producing petroleum in these countries, their ability to meet competition in European and North American markets is threatened, and some retrenchment and basic policy changes may be found necessary if the industry is to survive and prosper.

Increasing Demand

Consumption of petroleum products in Latin American countries is increasing rapidly. Growth of industries and establishment of new industries is notable in such countries as Brazil, Argentina, Colombia, and Mexico. The automotive industries are each year demanding more fuel. Much of the inland movement of people and freight is by motor buses and trucks. Commercial aviation is expanding rapidly; agriculture is being mechanized. As a result of these trends, Brazil's consumption of petroleum products was twice as much in 1949 as it was in 1943. Mexico's consumption of petroleum products in 1949 was 80 per cent greater than in 1937; a greater rate of increase than in the United States. Fortunately Venezuela, the largest producer, is still in a position to export a large percentage of her production but here too the domestic demand is rapidly increasing. Many years ago Argentina had an exportable surplus of petroleum but now must import half of her oil supply from other countries. Further development of Latin American industries promises a continued rapid expansion of their domestic markets for oil products.

Fundamental Differences

In sociological relationships it is difficult to overcome entirely the cleavages that naturally exist between people of different historical and racial

Fleet of diesel-powered launches, Lake Maracaibo.

backgrounds. Language barriers are also a handicap. South Americans generally admire and seek to emulate the industrial achievements of the United States and have patterned their concepts of democracy to conform with the example and traditions of the United States Government. Politically, the North and South American republics present a united front to the eastern world. In business relationships, however, it is sometimes difficult to erase the suspicions engendered by the earlier period of "Yankee imperialism." Latin Americans naturally resent exploitation of their people and natural resources for the benefit of foreign investors. They are often distrustful of the motives of those who seek concessions giving control of their industries and brook no interference with their inherent right to shape their own governmental and economic policies. Their customs demand a different approach from that the North American business man usually employs. Lack of understanding in these matters can sometimes be the cause of friction in business relationships.

Many U. S. citizens briefly visit South American countries or, perhaps, spend a few months or years in professional service or business activity, but they seldom stay long enough really to acquire a full understanding of the Latin American character and viewpoint. To succeed in this, one must go to stay and expect to make a place for himself under the conditions imposed by those who live there. He must learn the language, customs, and habits of the people; be one of them. The best exponents of North American culture are those who have done this; who have come to be known and respected by those with whom they have business and social relationships. The petroleum industry is gradually accumulating a staff of "old timers" among the corps of U. S. citizens in Latin American service. On them the industry must depend for guidance in maintaining cordial international relations.

Another effective means of promoting better international relations is that of giving encouragement to education of Latin American students in U. S. colleges and universities. During recent years, many students from various Latin American countries have spent one or more years in graduate work in U. S. professional schools. They have returned to their home countries with a better understanding of U. S. viewpoints and have become valued interpreters of our objectives and intentions among their own people. Some large oil companies with South American affiliates have fostered this plan and have assisted in the education of their native technical employees by providing graduate scholarships in U. S. colleges. In most cases, this academic preparation has been supplemented by a period of practical training in the U. S. petroleum industry before the student returns to his home-country job. Latin Americans trained in this way, may soon assume leadership in oil industry operations in their home countries.

Conclusions

In summarizing the foregoing review of the current position of the Latin American petroleum industry and its future prospects, the following conclusions may be drawn:

1. Of the several Latin American petroleum-producing countries, Venezuela is by far the most important. It has produced and is currently producing more than all the others combined. It also possesses nearly 80 per cent of the present known petroleum reserves in Latin American countries. Because of her outstanding production and reserve position and because a large part of her production is available for export, Venezuela is of particular interest.

2. In the vast only superficially explored area of South America and Mexico there is doubtless a large undiscovered reserve of petroleum that is likely to be the source of much of the oil supply for United States industries in future years. American oil companies should give continuing support to further development of the Latin American petroleum industry. Present known reserves in this region may become of vital importance to the United States in the event of a third world war.

3. Peace-time demand for South American petroleum is likely to be curtailed as a result of competition with cheaply produced petroleum from eastern sources, particularly in western Europe. The high production cost of South American oil is an adverse factor that promises to limit its ability to meet competition in world markets. War-time conditions, however, may deprive western markets of access to eastern petroleum sources, resulting in accentuated demand for South American oil.

4. Adverse conditions tending to discourage early development of additional South American petroleum reserves include exchange difficulties, legislation tending to restrict participation by foreign capital, political instability, high labor and material costs, poor transportation facilities, inaccessibility of prospective areas, hostility of natives and difficult climatic conditions. Latin American governments interested in promoting oil industry development in their countries should seek means of alleviating these difficulties.

5. U. S. oil company personnel charged with responsibility in cultivating better relationships with Latin American governments should make every effort to reach a better understanding of their political, economic, and social problems as viewed by the ciitizens of these countries. Where foreign capital is denied the privilege of direct access to natural resources, participation in the industry may be sought on a basis of service rendered rather than one of cold calculated profits based on control of resources. American oil companies are in a position to offer an invaluable service to the Latin American people in the form of skillful, competent, and experienced exploration, exploitation, refining, transportation, and management and financial assistance. Profit can be based on this service and control of resources and production is not a necessary consideration. * * *

"More Oil Wells and Steel Needed?"

A RECENT EDITORIAL* in the Petroleum Engineer pointed out the fact that the number of oil wells in the United States is not increasing much more than one-fourth as fast as last year's increase in crude oil demand despite the high drilling rate and concluded that more oil wells and steel are needed now and in future years, so that the U.S. may continue to have enough oil wells to supply the increasing demand for future years. Nothing was said about where the wells were to be drilled in the U.S. nor about well spacing.

Nevertheless, some readers inferred that the editorial was intended as an argument for the drilling of more oil wells in present oil producing reservoirs—an argument for closer spacing simply for the purpose of maintaining about the same rate of increase in the number of oil wells as in the demand. Those who drew such an inference may fear demands for closer spacing on some of the oil-producing leases that they are now holding with widely spaced wells. Such an inference might have been drawn from the facts related in the editorial; however, no operator need fear demands for closer spacing in any of the present fields where the spacing pattern and/or rules have been established by a sound engineering appraisal of reservoir conditions.

Although some may say that "wells don't produce oil," they are a vital part of the producing system—without which oil could not be produced. It is true, of course, that more wells have been drilled in a few fields than should have been necessary to produce the bulk of the oil in place. It is likewise true that the application of sound conservation measures to prevent the undue waste of reservoir energy has eliminated the necessity for drilling many wells in certain reservoirs. The installation of pressure maintenance systems in other reservoirs has also reduced considerably the number of wells required for producing the bulk of the oil. Such systems are praiseworthy for the increased amount of oil produced per well drilled, per pound of steel used, and per dollar invested. Secondary recovery installations are likewise praiseworthy for the increased production obtained from oil reservoirs that were almost depleted by primary methods of production.

It is important, particularly in times of national emergency, that unnecessary wells should not be drilled and that our oil reservoirs should be developed with as little steel as possible. Conservation measures, pressure maintenance, and secondary recovery systems should be applied as much as possible, so as to increase the availability of crude oil production. The primary development of our new fields and the redevelopment of our old fields with sufficient wells to produce the oil should not be delayed, however, by a lack of steel . . . otherwise we may find ourselves with insufficient wells to obtain the oil we have in our reservoirs when we need it most. More oil wells and steel for drilling and completing them are now an essential need for increasing the availability of the crude oil in our petroleum reservoirs.—K.M.F.

*November, 1950, Page B-3.

"KEEP IT CLEAN"

Just *choose the type* BAKER CASING SCRAPER your job requires

If you have ever tried to run a swab and had the rubber cups so badly torn and damaged that they were useless – if you have ever hit a spot through which a packer or cement retainer would *not* run and had the slips set prematurely – you already *know* that the inside walls of casing should be scraped clean.

There is no longer need to have imbedded bullets, burrs from gun-shot holes, a hardened cement sheath, or any other obstructions, cause you trouble. Anything that projects from, or adheres to the important "working surface" of casing – even down to mill scale or rotary mud – can be quickly, easily, safely and economically removed from the inside wall of the casing. And this vital work of scraping can be done either while the rotary rig still is up and you are drilling out the cement shoe; or at any convenient time by running the scraper on tubing or a wire line for vertical removal of obstructions.

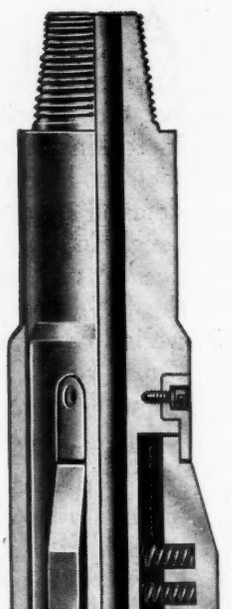
TWO TYPES OF BAKER CASING SCRAPERS MEET EVERY REQUIREMENT

The field-tested Baker MODEL "B" Casing Scraper (Product No. 620-B) is recommended for use when the rotary rig still is up and only hardened cement or a limited number of gun-shot burrs are to be removed. It is usually run just above the bit while drilling out cement, and will remove protruding burrs as well as the thin sheath of cement left even after the maximum gauge bit has been used for drilling out.

When there are several hundred gun-shot holes (with possible imbedded bullets); or if the hardened sheath of mud is to be removed from top to bottom of the well, the new Baker ROTO-VERT Casing Scraper (Product No. 620-C) is recommended. The ROTO-VERT can be run on drill pipe for successful vertical scraping of obstructions as it is being lowered in the hole, followed by rotation if difficult well conditions make rotation necessary or desirable; or it is run on tubing or a wire line for successful all-vertical scraping.

SCRAPING IS A VITAL PART OF WELL COMPLETION

Many operators consider that the use of a Baker Casing Scraper is a "must" in the completion of *every* new well, and after *every* gun-perforating job. They *know* that the inside wall of the casing is left smooth and "clean as a hound's tooth" ready to run a swab or testing



Baker MODEL "B" Casing Scraper
Product No. 620-B

Calibration Characteristics of Subsurface Pressure Gages

Precise measurements of bottom hole pressure can be made by determining hysteresis effect.

R. V. SMITH*, E. J. DEWEES†, R. H. WILLIAMS*

THE deflection that results from the action of pressure on a gage for measuring subsurface pressures in oil and gas wells may be converted to pressure by means of the gage modulus, the zero-pressure correction, and the curvature correction of the gage. Both the gage modulus and the zero-pressure correction are influenced materially by the temperature of a gage. When the pressure is increased to a maximum, for the particular range of a gage, and then decreased to a pressure less than the maximum, a fourth characteristic, hysteresis, also influences the deflection. The modulus, zero-pressure correction, and curvature correction are readily determined by calibration. Hysteresis effects depend upon the immediate pressure history of the gage, however, and even though their magnitude may be determined by special calibrations, the writers believe that conditions that produce hysteresis effects should be avoided in gage usage.

Accurate subsurface-pressure measurements are necessary for an understanding of many problems in oil and gas-production technology; they are especially important in research being conducted by the authors on the flow of fluids in gas wells. The determination of friction factors for flow in gas wells requires a high degree of accuracy in the measurement of subsurface pressures. Likewise, a high degree of accuracy is required when subsurface-pressure gages are used in back-pressure tests on "high-potential" gas wells. The results reported in this paper were obtained in attempts to calibrate and use the Amerada-type subsurface-pressure gage with the accuracy of measurement necessary for determining the pressure loss due to friction in flowing gas wells.

In a previous paper[1] the writers listed the sources of inherent errors in subsurface-pressure gage calibration and usage and gave methods for avoiding many troublesome sources of error. Data presented in that paper were limited to one gage that had a range of 0-1200 psi. In this paper the methods of calibration are extended to gages of widely different ranges, and the calibration characteristics of seven Amerada-type subsurface-pressure gages with upper pressure limits ranging from 700 to 7000 psi are described. In addition, the curvature characteristics and hysteresis effects that were found by this study are given.

Contributions to the technique of using and calibrating subsurface-pressure gages have been made by several writers.[2,3,4] Brownscombe[5] has reported hysteresis loops for a gage with an upper pressure limit greater than 3620 psi. The writers' study of hysteresis effects agrees for the most part with conclusions reached by Brownscombe in working with one gage.

In the study of the calibration characteristics of the Amerada-type subsurface-pressure gage, deflections and corresponding calibration pressures were fitted to a linear relationship by the method of least squares. This procedure results in modulus values (the slope of the least-squares line, or the pressure increment required to cause a change in the deflection of 1 in.) and zero-pressure corrections (the intercept of the least-squares line on the pressure scale at zero deflection) for each calibration temperature. All of the gages described in this report had similar deviations from the straight-line relationship of deflection with pressure that indicated definite curvature characteristics. Although an equation of higher order than the proposed linear relationship of deflection with pressure fitted the data more closely, virtually the same results are accomplished more easily by using the linear equation with a curvature correction because the computations to arrive at the constants for a higher order equation are lengthy and laborious. This is possible because the curvature corrections for the gages depended only upon the pressure applied to the gage and were found to be independent of the temperature of the gage. At a given temperature, the deflection caused by a pressure applied to an Amerada-type subsurface-pressure gage may be converted to pressure by the use of three gage characteristics, provided hysteresis effects have not been introduced. These three characteristics are gage modulus, zero-pressure correction, and curvature correction.

Values of the modulus vary with the temperature of the gage; consequently, calibrations must be made at several temperatures covering the range of temperatures found in wells. The writers' experience indicates that modulus values determined by successive calibrations on the gages with different charts differ by 0.1 to 0.4 per cent.

Values of the zero-pressure correction may vary widely from calibration to calibration without an apparent cause, but the change in zero-pressure correction with temperature is relatively constant and can be determined by calibration. In field use of the gages, a zero-pressure correction must be determined every time the gage is used in a well, even though several pressure surveys are recorded on the same chart.

After hysteresis effects are introduced in pressure measurements, the exact error in the measurements caused by hysteresis can be determined only by calibrations over an identical pressure cycle. Unless corrections are made for hysteresis effects, errors of considerable magnitude may result. As an example, a hysteresis error of 39 psi is possible with the 7000-psi-range instrument described in this report. Techniques that introduce hysteresis effects should be avoided to obtain maximum accuracy of measurement in the use of subsurface-pressure gages.

Experimental Procedure

The pressure element of the Amerada-type subsurface-pressure gage is a helical tube with the upper end sealed and free to move. In 6 of the gages studied, applied pressures were transmitted through a sylphon-bellows arrangement to the lower end of the helical tube; the 700-psi-range instrument was not equipped with a sylphon bellows. As the lower end of the helical tube is fixed to the gage frame, an increase of pressure causes

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[1]References are given at the end of the paper.

EXCLUSIVE

an uncoiling motion of the upper end of the tube, this motion being transmitted to a stylus point by a shaft. The stylus points used in this study were "Permopivot" phonograph needles, and the charts were made of polished aluminum foil with "full hard" temper. The Permopivot points made lines on the charts that were less than 0.001-in. wide.

The gages were calibrated by applying a range of pressures, determined with a piston gage, at several calibration temperatures and then measuring the resulting deflections of the stylus from the zero-pressure line with a comparator microscope. The zero-pressure line or base line from which all deflections were measured was marked on the chart after the gage had been brought to the lowest calibration temperature used for a particular gage. The essential features of the equipment for calibrating the gages, which have been described in detail in an earlier paper,[1] are an oil pump to supply pressure, a calibrated piston gage to measure pressure, an air chamber to cushion momentary pressure surges from the pump, and a water or oil bath to maintain the gages at various desired temperatures during calibration.

Pressures indicated by the piston gage were corrected for the pressure of the head of oil resulting from the difference in elevation between the piston gage and the subsurface gage. The 700-psi and the 1200-psi-range gages were calibrated at 6 pressures at even intervals through the range of the gages. Gages of higher ranges were calibrated at 7 pressures covering the range of the instruments. Calibration temperatures were chosen at 20 F intervals over the range of temperatures that are found in well testing.

Table 1. Average modulus values for 7 subsurface-pressure gages.

Upper pressure limit of gage, psi	Modulus, psi corresponding to a change of deflection of 1 in. at calibration temperature °F.						
	60	80	100	120	140	160	180
700	362.2	360.8	359.1	357.5	356.3	....	....
1,200	634.5	631.9	629.5	627.3	624.7	622.3	619.7
2,800(1)[1]	1,452.2	....	1,441.3	....	1,430.2	....	1,419.3
2,800(2)[1]	1,454.4	....	1,442.6	1,436.8	1,431.8	1,427.5	1,421.2
4,000	....	....	2,005.2	1,997.5	1,990.6	1,981.6	1,973.2
6,300	....	....	3,279.8	3,266.4	3,254.7	....	3,229.5
7,000	....	....	3,580.5	3,566.6	3,553.4	3,538.6	3,527.2

[1] Duplicate gages.

Computing Calibration Results

Deflections measured from the calibration charts and corresponding pressures measured with the piston gage at each calibration temperature were fitted by the method of least squares to the following linear equation:

$$P = mD + a \quad \ldots\ldots\ldots \quad 1$$

where

P = pressure, psi,
m = gage modulus, psi (pressure corresponding to a change in deflection of 1 in.)
D = deflection, in. (pressure deflection of the stylus from the zero-pressure line)
a = zero-pressure correction, psi

Modulus and zero-pressure correction values were computed from the calibration results for a given calibration temperature by the following least-squares equations:

$$m = \frac{\Sigma (P)\, \Sigma (D) - n \Sigma (PD),}{(\Sigma D)^2 - n \Sigma (D^2)} \quad \ldots\ldots\ldots \quad 2$$

and

$$a = \frac{\Sigma (D)\, \Sigma (PD) - \Sigma (D^2)\, \Sigma (P),}{(\Sigma D)^2 - n \Sigma (D^2)} \quad \ldots\ldots\ldots \quad 3$$

where

Σ = sum,
n = number of determinations.

Modulus and zero-pressure correction values computed in this manner may be defined, respectively, as the pressure increment required to cause a change in deflection of 1 in. and the calculated pressure equivalent of the zero deflection of the gage. Zero-pressure corrections are related to the rest position of the gage. The effects of the gage modulus and the rest position on deflection can be separated and studied individually through the analysis of calibration results by the method of least squares.

Modulus Values

Modulus values and zero-pressure corrections were computed by the method of least squares from the results of calibrations on the 7 gages at several temperatures. Calibration temperatures were chosen to cover the anticipated temperatures at which the gage would be used to measure pressures in wells. The arithmetic averages of the modulus values obtained from several calibrations at each calibration temperature are given in table 1 where the gage modulus is shown to decrease with an increase in calibration temperature. This relationship is shown on Fig. 1, where modulus has been plotted against calibration temperature for the 7000-psi- and the 2800 (2)[2]-psi-range instruments, and

[2] Duplicate 2800-psi-range instruments are identified by the numbers in parentheses.

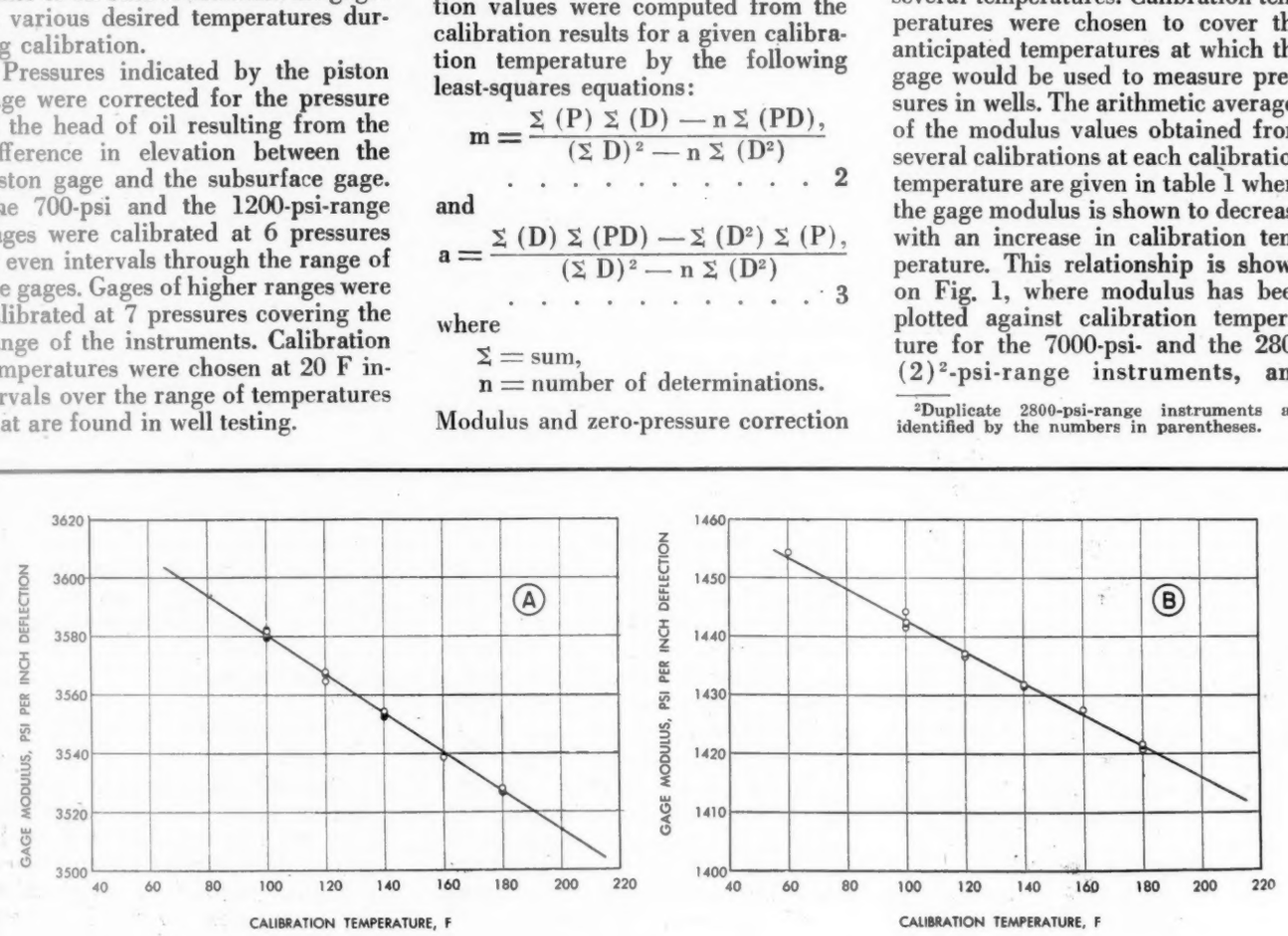

FIG. 1. Change of gage modulus with temperature. (A) — 7000 psi range subsurface-pressure gage; (B) — 2800 (2) psi range subsurface pressure gage.

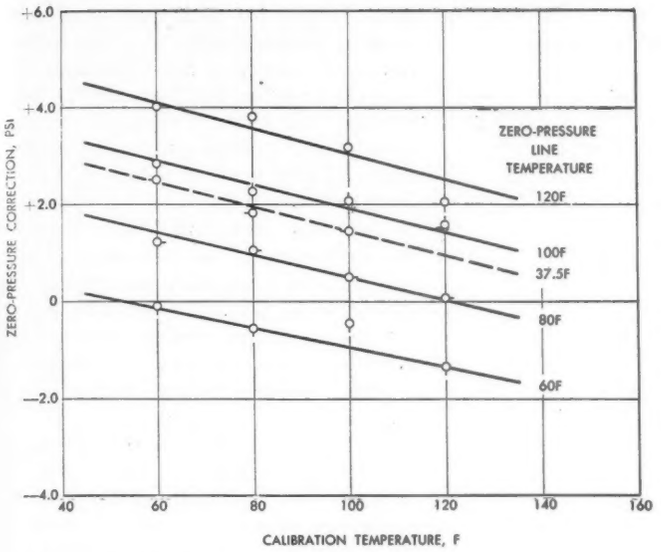

FIG. 2. Zero-pressure corrections for a 1200 psi range subsurface pressure gage.

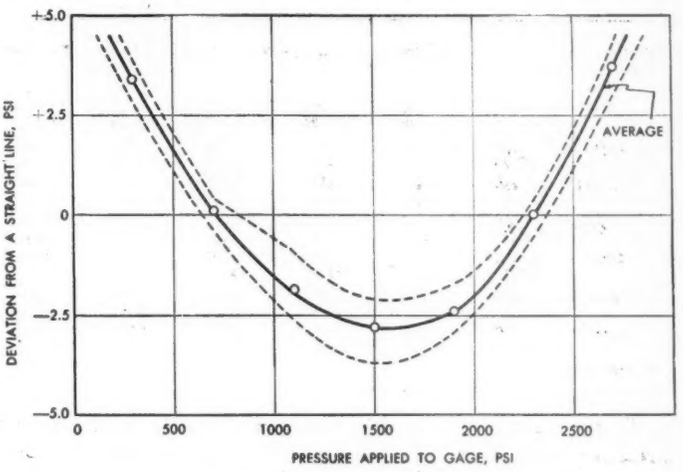

FIG. 3. Average deviation and spread of deviations from a straight line for 2800 (2) psi range subsurface-pressure gage.

straight lines have been drawn through average values. Variations of the points from the lines are probably within the experimental accuracy of the method. Plots of the modulus against temperature provide a convenient means of interpolating between calibration temperatures.

The agreement between several determinations of the modulus at a given temperature is illustrated also in Fig. 1. Six determinations of the modulus at 100 F for the 2800 (2)-psi-range instrument gave values that varied from 1441.5 to 1444.1—a difference of about 0.2 per cent. The 7000-psi-range gage showed an agreement of 0.1 per cent between determinations at 120 F. A maximum variation of 0.4 per cent was observed for the 1200-psi-range instrument over a period of 7 months, which included extensive use of the gage in the field. Similar close agreements between modulus values were obtained with the other subsurface-pressure gages. New gages or gages unused for long periods of time may show modulus values that vary more than the examples given above. Frequently, close agreement between calibrations may be attained after repeated calibrations.

Zero-Pressure Corrections

The value of the zero-pressure correction is influenced by several factors, including: (1) Change of the correction with calibration temperature, (2) change with the temperature of the gage at which the zero-pressure line was placed on the chart, and (3) change in characteristics resulting from the past use of the gage. These characteristics are illustrated in Fig. 2 for the 1200-psi-range subsurface-pressure gage where zero-pressure corrections at the different temperatures used in establishing the zero-pressure line were plotted as a function of the calibration temperature, and straight lines were drawn through the points. The position of the points shows that the lines have approximately identical slopes, indicating that the data form consistent relationships with calibration temperature. The vertical displacement of the lines indicates that the temperature of the gage at the time the zero-pressure line was placed on the chart materially influenced the zero-pressure correction.

The position of the line for the calibration in which the zero-pressure line was placed on the chart at 37.5 F with regard to the other lines in Fig. 2 illustrates a condition that could not be traced to any known cause except, possibly, the past history of the gage. This phenomenon was observed in each of the 7 gages studied. Precautions such as marking the zero-pressure line on the chart with the calibrating adapter at the bottom of the pressure element open to the atmosphere and free of oil and water did not prevent the variation in position of the zero-pressure corrections. The zero-pressure corrections are related to the position of the zero-pressure line on the chart that is established with the pressure element free of pressure. It is possible that even minor friction effects change the rest position slightly and that the magnitude of the change depends in some way upon the procedure by which the last pressure that was acting upon the gage was relieved.

Even though the values of the zero-pressure corrections appear to change in an erratic manner, the slope of the straight line drawn through the plot of zero-pressure corrections against calibration temperature was found to remain relatively constant for each of the gages studied. Arithmetic average values of the change of zero-pressure correction with temperature, as determined by several calibrations, are given for the 7 gages in Table 2. Plots of zero-pressure corrections against calibration temperature form straight lines with negative slopes for 5 of the gages but plots of the data for the 700-psi- and the 6300-psi-range instruments form lines with positive slopes. Although the cause of this difference in the characteristics of the gages was not determined, the writers believe that the difference does not affect the accuracy that can be attained with the gages. In using the gages to measure pressures in wells, the zero-pressure correction must be determined at a measured temperature for each set of pressure measurements.

Table 2.—Change of zero-pressure correction with temperature for 7 subsurface-pressure gages.

Upper pressure limit of gage, psi	Average slope of zero-pressure correction psi per °F
700	+0.029
1,200	— .025
2,800(1)[1]	— .030
2,800(2)[1]	— .007
4,000	— .058
6,300	+ .070
7,000	— .038

[1] Duplicate gages.

Curvature Characteristics of Gages

Use of the method of least squares

Table 3. Average deviation from a straight line showing the curvature characteristics of 7 subsurface-pressure gages.

Upper pressure limit of gage, psi	Calibration pressure, psi, with average deviation, psi given below							Number of observations at each pressure
700	100	200	300	400	500	600	....	15
	+0.35	−0.05	−0.25	−0.33	−0.08	+0.37	....	
1,200	100	300	500	700	900	1,100	....	41
	+0.25	+0.10	−0.22	−0.40	−0.10	+0.39	....	
2,800(1)[1]	300	700	1,100	1,500	1,900	2,300	2,700	9
	+1.9	+0.3	−1.3	−1.6	−1.4	−0.1	+2.4	
2,800(2)[1]	300	700	1,100	1,500	1,900	2,300	2,700	14
	+3.4	+0.1	−1.9	−2.8	−2.4	0.0	+3.7	
4,000	750	1,250	1,750	2,250	2,750	3,250	3,750	16
	+3.5	+0.3	−1.8	−3.1	−2.7	−0.4	+4.3	
6,300	500	1,000	2,000	3,000	4,000	5,000	6,000	14
	+6.0	+2.1	−3.4	−5.8	−5.3	−0.9	+7.6	
7,000	500	1,500	2,500	3,500	4,500	5,500	6,500	19
	+4.6	+0.5	−2.8	−3.7	−3.7	−0.5	+5.4	

[1] Duplicate gages.

to find a linear relationship between pressure and deflection presupposes that a linear relationship does exist. Actually, as will be shown, deflection is not a straight-line function of pressure. The departure from a straight line is not great, however, and the systematic deviation from a straight line has been termed the curvature characteristics of the gages. Also, the term "deviation from a straight line" as used in this report is the difference between the actual pressure applied to a subsurface-pressure gage and the pressure indicated by the gage; the term "deviation from a curve" is the difference between the actual pressure applied and the pressure indicated by the gage after correction for the curvature characteristics of the gage. The pressures indicated by the gage were computed by substituting the deflections, modulus values, and zero-pressure corrections into equation 1 and completing the indicated arithmetic operations.

$$P = mD + a \quad . \quad . \quad . \quad . \quad . \quad . \quad 1$$

Deviations from straight lines at all calibration temperatures for the 2800 (2)-psi-range instrument, illustrated in Fig. 3, are plotted against calibration pressure. A solid curve was drawn through the average of the deviations at each calibration pressure (each circle represents 14 observations), and dashed curves were drawn through the limits of spread of the deviations above and below the average values. The spread of the deviations from a line was slightly greater at the trough of the curve, near 1500 psi, than at either end of the curve. The maximum spread of the deviations, 1.6 psi at 1500 psi, is considerably less than the total curvature of the curve drawn through the average deviations.

The curvature characteristics of 7 gages are given in Table 3, each gage having characteristics similar to those illustrated on Fig. 3 for the 2800 (2)-psi-range instrument. As shown in Table 3, the average deviations from a straight line are positive at the lower and higher calibration pressures and negative at the intermediate pressures. The 1200-psi-range instrument had the least total deviation from a straight line of the instruments studied.

The deviations from a straight line presented in Fig. 3 and in Table 3 show conclusively that deflections for the gages studied are a curve rather than a straight-line function of the pressure applied. The relationship between deflection and applied pressure could be expressed closely by the addition of a second term containing a second constant multiplied by the square of deflection, to equation 1. The computations resulting from the use of a second-degree equation would be long and tedious, however, making the method impracticable. The same result can be accomplished by adding a curvature correction to equation 1,

$$P = mD + a + C, \quad . \quad . \quad . \quad . \quad 4$$

where

C = curvature correction, psi

Values of the curvature correction C, for a particular gage, corresponding to a given product of modulus times deflection (mD in equation 4), may be taken from charts similar to Fig. 3.

Deviations from a curve can be calculated by subtracting pressures indicated by equation 4 from the pressure applied to the gage. A summary of the observed deviations from a curve is given in Table 4 for the 7 gages. The arithmetic average of the deviations from a curve for each gage at all calibration temperatures is given in the fourth column and the maximum observed deviation is given in the last column. The average deviation varies from 0.010 to 0.015 per cent of the range of the gage, and the maximum observed deviation was 3 to 5 times the average deviation. Table 4 gives an indication of the accuracy of the gages under laboratory conditions. As temperature did not affect the deviations of the gages, plots similar to Fig. 3 are used conveniently for determining the curvature corrections for given pressure measurements.

As the gages used in this investigation showed definite curvature characteristics, successive calibrations on the same gage must be made in similar pressure steps over the range of the instrument, otherwise slightly different modulus values and zero-pressure corrections would be obtained. For example, the data illustrated in Fig. 3 for the 2800 (2)-psi-range instrument show the curvature for a series of calibration pressures in intervals of 400 psi from 300 to 2700 psi. If the calibration pressures had covered only the range from 300 to 1500 psi the least-squares line would have been fitted to the data on the left half of Fig. 3. As the zero-deviation line represents the least-squares line for the whole pressure range, the line for half the pressure range would have a different position. Hence, the modulus (the slope of the least-squares line) and the zero-pressure correction (the calculated pressure indicated by the gage at zero deflection) for half the pressure range would be different from those for the whole range. Because of the curvature characteristics of the gages, similar calibration-pressure ranges and intervals must be used to obtain comparable modulus values and zero-pressure corrections.

Hysteresis Characteristics of Gages

If a subsurface-pressure gage is subjected to a series of pressure increments and if, after the highest pressure is reached, the series is repeated in decrements of pressure, the deflections produced at given pressures by the

Table 4. Average deviations from a curve at all calibration temperatures for 7 subsurface-pressure gages.

Upper pressure limit of gage, psi	Number of calibration points	Sum of deviations, psi	Arithmetic average deviation, psi	Maximum deviation observed, psi
700	90	7.21	0.08	−0.27
1,200	246	45.15	.18	− .79
2,800(1)[1]	63	17.0	.3	− .9
2,800(2)[1]	98	30.5	.3	− .9
4,000	112	59.1	.5	+1.9
6,300	98	54.8	.6	−1.9
7,000	132	85.9	.7	−2.1

[1] Duplicate gages.

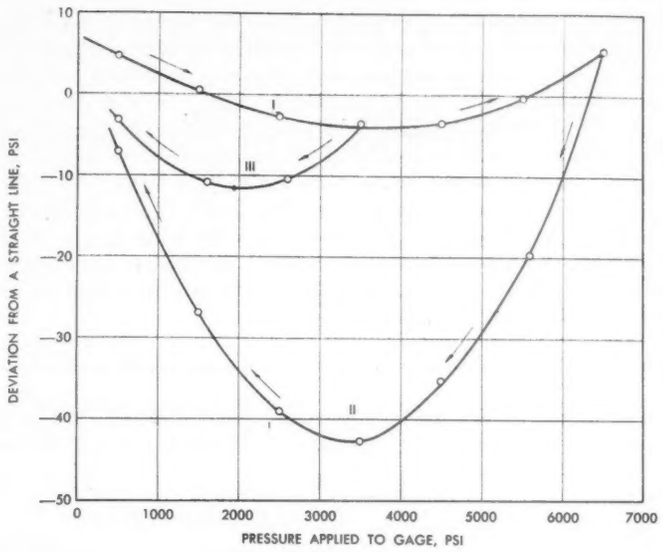

FIG. 4. Hysteresis loops for a 7000-psi-range subsurface-pressure gage.

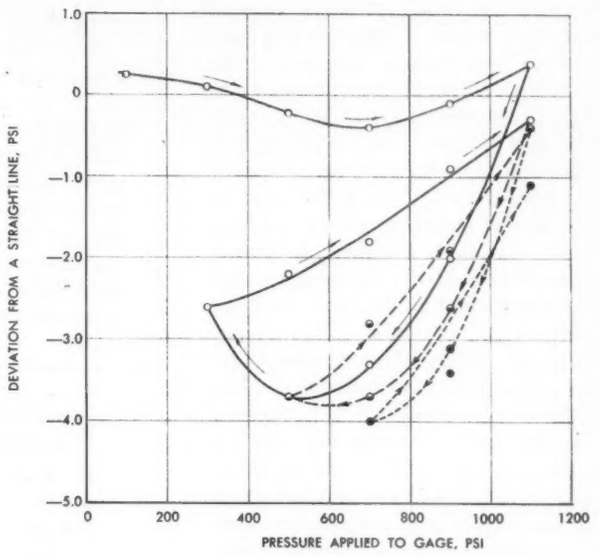

FIG. 5. Hysteresis loops for a 12000-psi-range subsurface-pressure gage induced by applying and reducing pressure in cycles.

"decreasing" pressure series will be greater than those produced at the same pressures by the "increasing" pressure series. This phenomenon is known as hysteresis. Two hysteresis loops for the 7000-psi-range instrument are illustrated in Fig. 4 by curves 2 and 3; the arrows on the curves indicate the sequence of pressures applied to the gage. Curve 1 shows the magnitude of the deviation from a straight-line relationship between deflection and pressure for a normal "increasing" pressure calibration starting from atmospheric pressure. The experimental points for curve 2 were obtained by applying increasing pressures in steps up to 6500 psi and then decreasing the pressures by steps through 5500, 4500, 3500, 2500, 1500, and 500 psi. The low of the trough of the hysteresis loop came at 3500 psi, where the pressures indicated by the gage, computed from a normal calibration, deviated 42.7 psi from the pressure applied to the gage. Subtracting the normal curvature correction of the gage of 4.0 psi from 42.7 psi, a hysteresis deviation of 38.7 psi is obtained. Curve 3 was obtained by increasing the pressure to maximum of 3500 psi and then decreasing the pressure in steps to atmospheric. The depth (about 10 psi) of the hysteresis loop, curve 3, is much less than that of curve 2. Hysteresis experiments for intermediate maximum pressures produce loops having intermediate depths. Deviations caused by hysteresis depend upon the maximum pressure applied to the gage (within the working-pressure range of the particular gage), as well as the characteristics of the individual gage.

The deviations resulting from multiple hysteresis effects are illustrated in Fig. 5 for the 1200-psi-range instrument. Arrows indicate the sequence of pressures applied to the gage. The curve in the upper portion of Fig. 5 shows the normal curvature characteristics of the gage. The points joined by the solid curves represent the normal calibration at pressures up to 1100 psi, the hysteresis loop at pressures down to 300 psi, and then increasing pressures from 300 to 1100 psi. From 1100 psi the pressure was decreased to 500 psi and increased to 1100 psi, again producing the points (half black) joined with curve of long dashes. The pressure then was decreased from 1100 to 700 psi, following which it was increased again to 1100 psi, giving the solid points joined by a curve of short dashes.

Three important points illustrated by Fig. 5 are, first, the magnitude of the hysteresis effects; second, the fact that hysteresis effects after being created are not removed by increasing pressures; and third, fatigue in the pressure element produced by application of pressures for a period of 2½ hours causes the deviations to increase. The experiment, illustrated graphically in Fig. 5, was continuous, and the fatigue of the pressure element is shown by the progressive downward drift of the points at the pressure of 1100 psi.

Similar hysteresis characteristics were found in all the gages studied, and the deviations induced by hysteresis in the gages are summarized in Table 5. The first loop described for each gage was stopped at a maximum pressure near the pressure limit of the gage, and the second loop was stopped at a maximum pressure that is approximately half the pressure limit of the gage. Deviations shown in the table were measured at the end of each pressure cycle. The maximum deviation caused by hysteresis is related to the maximum pressure applied to the gage and is characteristic of the individual gage.

The use of subsurface-pressure gages in tests involving pressure decreases, such as "draw-down" tests on oil or gas wells, requires a special cali-

Table 5. Hysteresis characteristics of 7 subsurface-pressure gages.

Upper pressure limit of gage, psi	Hysteresis loop		Hysteresis loop	
	Pressure cycle, psi	Deviation at end of cycle, psi	Pressure cycle, psi	Deviation at end of cycle, psi
700	0 to 600 to 300	— 1.8	0 to 400 to 300	— 0.8
1,200	0 to 1,100 to 600	— 3.8	0 to 700 to 400	— 1.8
2,800(1)[1]	0 to 2,700 to 1,500	—15.4	0 to 1,500 to 900	— 5.6
2,800(2)[1]	0 to 2,700 to 1,500	—12.7	0 to 1,500 to 1,100	— 3.8
4,000	0 to 3,750 to 2,250	—11.8	0 to 2,250 to 1,750	— 5.3
6,300	0 to 6,000 to 3,000	—40.8	0 to 3,000 to 2,000	—12.1
7,000	0 to 6,500 to 3,500	—42.7	0 to 3,500 to 2,000	—11.2

[1] Duplicate gages.

bration of the gage to account for the particular hysteresis effect or a technique in which the gage is not subjected to decreasing pressures. In measuring decreasing pressures within wells, Bureau of Mines engineers have followed the practice of bringing the pressure gage to the surface, releasing the pressure, and allowing the gage to "rest" for at least 30 minutes before measuring a lesser pressure. As an exact determination of a hysteresis effect requires a special calibration over the pressure cycle, the most convenient method of obtaining accurate pressures is one that avoids conditions that produce hysteresis effects. If hysteresis effects are ignored pressures may be in error, for example, by as much as 39 psi in the 7000-psi-range instrument. The errors that may be involved in the other gages are given in Table 5 and Figs. 4 and 5.

Computing Pressures from Deflections

The three calibration characteristics of subsurface-pressure gages, used as a basis for converting deflections to pressures, are: (1) Gage modulus (Table 1), (2) change of zero-pressure correction with temperature (Table 2), and (3) curvature correction or curvature characteristics of the gage (Table 3). Conversion of deflections to pressures by these characteristics requires a knowledge of the temperature of the gage at each deflection and a determination of the zero-pressure correction each time the gage is used in a well.

The zero-pressure correction can be determined conveniently by measuring with a piston gage the pressure on the subsurface gage while it is in the lubricator on the wellhead. An alternate method applicable to shut-in gas wells is to determine the pressure on the subsurface gage while it is at a depth of 50 ft in the well by measuring the wellhead pressure and adding the pressure caused by the weight of the column of 50 ft of gas. The pressure resulting from the weight of 50 ft of gas may be calculated accurately by the methods of Rzasa and Katz.[6] The advantage of this method is that, at a depth of 50 ft, the gages are not exposed to variable temperature conditions possible in the lubricator at the wellhead.

These recommendations may be carried out by determining the zero-pressure correction of the gage at lubricator temperature or the temperature at a depth of 50 ft from the following equation:

$$a = P_1 - m_1 D_1 + C_1 \quad . \quad . \quad . \quad 5$$

where

a = zero-pressure correction, psi, at the temperature of the subsurface gage in the lubricator or at a depth of 50 ft, as the case may be,

P_1 = known pressure acting on gage, psi,

m_1 = gage modulus, psi per inch deflection, corresponding to the temperature of the gage,

D_1 = deflection, inches, indicated by the subsurface gage at P_1,

C_1 = curvature correction, psi corresponding to $m_1 D_1$ and used with the proper sign.

At relatively high temperatures, the zero-pressure correction decreases or increases with temperature according to the slope of the zero-pressure correction line with temperature for a particular gage. Pressures at depths below the wellhead may be computed then by means of equation 6:

$$P_s = m_s D_s + a + K(t_s - t_w) + C_s \quad . \quad . \quad . \quad 6$$

where

P_s = subsurface pressure, psi, at depth s in the well,

m_s = gage modulus, psi per inch deflection, at the temperature of the subsurface gage at depth s in the well,

D_s = deflection, inches, corresponding to P_s,

a = zero-pressure correction, psi, computed by equation 5,

K = change of zero-pressure correction with temperature, psi per °F,

t_s = temperature, °F, at depth s,

t_w = temperature, °F, at which the zero-pressure correction, a, was determined,

C_s = curvature correction, psi, corresponding to $m_s D_s$.

In the foregoing equations the curvature correction has been determined by the product of modulus times deflection instead of the actual pressure on the gage. The error introduced in this way will be negligible because the curvature correction is small compared with the pressure applied to the gage.

Opposes Drilling "Island." A proposal for joint city and state development on offshore state park property seaward from Alamitos Bay, California was characterized as dangerous to the city's tideland interest in an opinion delivered to the Long Beach city council by city attorney Irving M. Smith. The proposal outlined to the council's harbor committee calls for construction of a mile-long jetty at the entrance to the bay, and construction of a 100-acre island to be built from silt dredged from 52 acres of tidelands recently acquired by the city. Smith advised the city council that the proposal if carried out "would rock the boat at a critical time when our title to the tidelands is in jeopardy." Smith also said, "We must be careful not to give the federal government any provocation to seize control of the tideland areas."

Acknowledgments

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References

1. Smith, R. V., and Dewees, E. J., Sources of Error in Subsurface-Pressure Gage Calibration and Usage: Oil and Gas Jour., vol. 47, December 9, 1948, pp. 85-98.
2. Brownscombe, E. R., and Conlon, D. R. Precision in Bottom-Hole Pressure Measurement: AIME Tech. Pub 1942, Petro. Tech. November, 1945.
3. Perkins, H. W., and Chaney, P. E., An Investigation of Errors in Bottom-Hole Pressure Measurement: Oil and Gas Jour., vol. 46, June 14, 1947, pp. 102-106.
4. Hawkins, M. F., Jr., Method of Least Squares Applied to Bottom-Hole Pressure Gage Calibration: Petrol. Engr., vol. 19, Apr. 1948, pp. 93-94.
5. Brownscombe, E. R., A Field Calibration Technique for Bottom-Hole Pressure Measurement: Petrol. Engr., vol. 18, Aug. 1947, pp. 84-88.
6. Rzasa, M. J., and Katz, D. L., Calculations of Static Pressure Gradients in Gas Wells: Petro. Engr., Reference Annual, vol. 16, 1945, pp. 148-158.

* * *

The Effect of Patents on Petroleum Production, Operation, and Development*

PAUL F. HAWLEY†

Abstract

Patents on advances in petroleum technology have been obtained ever since the petroleum business became commercially important. Most important developments have thus been protected in their initial growth.

The effect of patents in petroleum development and exploration has been twofold. In the first place, expiration of earlier patents has given the public the right to use these developments. In the second place, presence of patent protection in the early life of small companies has assisted their growth and increased the effectiveness of their service to these branches of the oil industry.

SPEAKING for the moment as an engineer, in which field I received my early training, I recall very distinctly what little attention I gave to this major tool, which has long been very effective in the growth of our industrial civilization. Probably you do not share that ignorance, because in the past few years considerable publicity has been given the patent system and its influence on technology. Unfortunately, much of the discussion has been by pressure groups both in industry and in our Federal Government and has shown a narrow understanding of the fundamentals of this system. As a result, there has been agitation for revision, many proposals in effect practically wiping it out. I am worried about such viewpoints, as I feel that the facts have been deliberately distorted through intent or ignorance, and I believe, among others, that it should definitely be the job of the engineering founder societies to take an active interest in correcting such misimpressions and rumors.

Basically, the drafters of our Federal Constitution were not interested in fostering the welfare of *inventors* when they placed in that very important document the right of Congress "to promote the progress of science and useful arts by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries." The very language indicates that the basic purpose was to promote public welfare. The first patent laws, passed very shortly after the United States was organized, set up the basic structure on United States patents, which has been followed ever since. Stripped of all fancy language, a patent is a contract between an inventor and the United States Government, in which the inventor is given the right to keep all others from using his invention for a limited period of time (now 17 years) in return for publishing his invention, so that at the end of this time anyone in this country may use the invention fully and freely. This public benefit was considered of sufficient importance to grant the inventor an initial right of protection until the particular invention could get on its feet.

That the system has worked well in general is witnessed by our enormous strides in material prosperity. Further testimony is the fact that all other major industrial nations have patent systems of one sort or another, and the one nation which abandoned the system for a time—the Netherlands—after a few years found it necessary to reinstate its patent laws.

The operation of the system is sufficiently simple so that it should be well known to all of us. It revolves about what we call the patent grant, i.e., the right given the inventor in return for the publication of his invention. This grant is simply the right to keep others from making, using, or selling the invention, as defined at the end of the patent by the various claims. No right is given the inventor to make, use, or sell the invention himself. For example, an inventor of an improvement on a patented pump must secure from the first inventor the right to make his pump before he in turn can make his own improvement. He shares with the rest of the general public the right to use all inventions on which the patents have expired.

Putting it another way, he has the same right to keep others from using this kind of property that a farmer has to keep others from stealing his watermelons or the gold miner from letting another man jump his claim. Very frequently, current reformers refer in terms of horror to the "patent monopoly." This term, to say the least, is misleading. I have the same monopoly in the ownership of my automobile that I have in my ownership of a patent. In fact, more so—for, if I were conservative and lucky enough to be able to run my automobile for more than seventeen years from the date I bought it, I could still keep my automobile, whereas I can keep no one from using my invention in any way he wishes after the seventeen-year life of the patent is past.

This comment about patents and automobiles involves another point which is necessary to consider with regard to patents. My new automobile today is certainly of considerable value. But, in a relatively few years, advances in style and—I hope—advances that mechanical engineers will make in the equipment will render my 1950 model obsolete. Similarly, the constant uninhibited advance of research makes it the rare patent indeed which is valuable seventeen years from the date it issues. In my experience with patents in the producing and exploration end of the oil industry, it is unusual to find a patent of considerable value after ten years; and, indeed, in many cases an effective life of two or three years is considered lucky.

Another criticism of the patent system deserves passing comment. Many adverse comments do not take into account the fact that the system is not static—it changes with time. Things which were good patent practice around the turn of the century would never be permitted at the present time. Here is one simple example of this: It used to be perfectly legal for an inventor who had developed a new machine to require his licensees to buy their feed for the machine from him, even though the feed materials might be entirely unpatented. In

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1896, the federal courts put their stamp of approval on an agreement which a shoe-machinery company had made, requiring those who used its button-fastening equipment for shoes to buy their buttons from the patent owner. The buttons themselves were simple, ordinary, unpatented buttons which could be purchased from many others. Then, in a very real sense, the patent owner had a monopoly, using that word as we properly should to mean depriving the public of the right to use something it *already* had a right to use—in this case, shoe buttons. Now, just a few years ago, a rather parallel situation arose in which a large salt company owned a patent on a salt-dispensing machine for putting salt tablets into canned food just before the lid was put on and the can processed. Their agreement for the use of the patented salt dispenser required their customers to purchase the unpatented salt tablets from them. The Supreme Court of the United States refused to permit such agreements to stand. In other words, the pendulum had swung so far legally that they were refused the benefit of their own patent as long as they tried to carry out a practice which was perfectly legal in 1896!

Our courts have been very critical of many other practices in patent agreements, which were formely considered legal. They have wiped out the right of the patent owner to control the resale price of a patented article. They have refused to permit several owners of patents relating to a single article to combine and fix the minimum price for the resulting article, or to use the combination of patents to keep manufacture by others available only on a license which restricts the amount of use or the marketing area in which the commodity can be sold or contains other non-competition devices.

Now, I am not one to say that the patent system at the present time is perfect, but I do believe that much of the criticism now being leveled at patents is made without regard to the changes in the system which have been made over the last few decades.

As far as the effect of patents in the fields with which I am better acquainted is concerned, i.e., in the fields of exploration and production of oil, it does not appear to me that really adverse effects can be found, while the benefits that have been obtained, I think, have been very definite. These benefits have been exactly what the original establishers of the system were looking for. In the first place, the constant expiration of older patents is continually widening the field in which the oil industry can operate freely. In the second place, the use of patents in their period of life has enabled many small concerns to reach maturity and furnish the industry with improved methods and apparatus for more effective exploitation of an irreplaceable commodity.

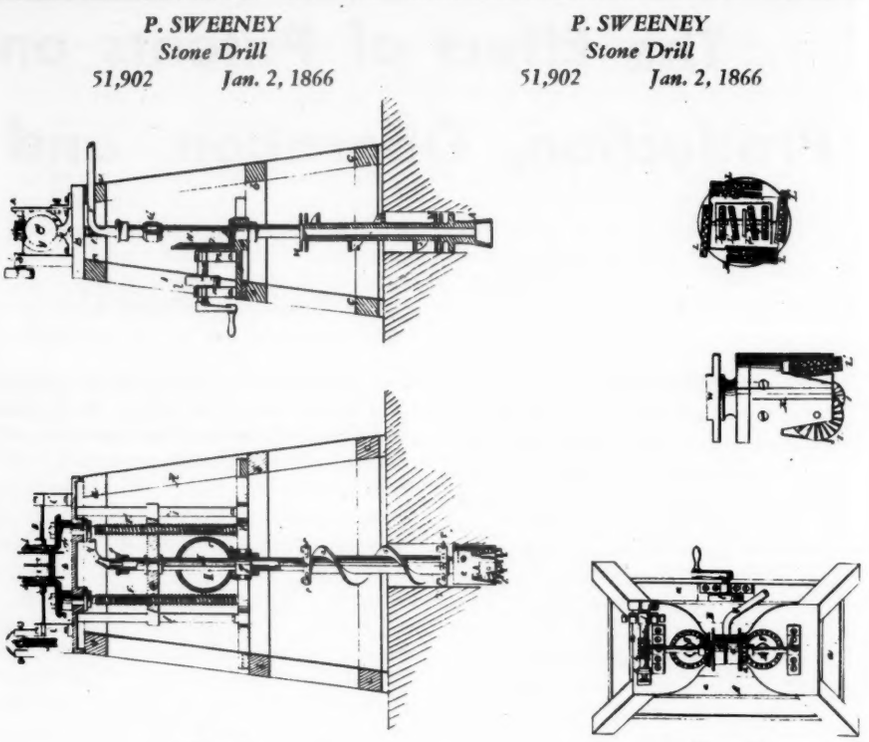


Fig. 1 Fig. 2

Let us first consider the effect of the expiration of early patents in the production end of the industry. To many of you, I believe, the dates of some of the early patents in major fields of current interest in drilling, completing, and producing wells will be a surprise. A good reference date for purposes of thinking is that of the completion of the Drake well in 1859. A study of our files, which may be incomplete as far as the most basic patent is concerned, shows, for example the Sweeney patent of 1866 (Fig. 1), which shows a rotary drilling system, a mechanical screw-down to force the bit into the formation, and (Fig. 2) even a roller bit, which at least appears workable today. Dow's diamond stone drill patent of 1866 (Fig. 3), shows that diamond core barrels are not exactly the newest thing in the field.

One of the recent systems of drilling in the Gulf, which has been considered excellent, used a small drilling platform containing only the equipment necessary to drive the drill string, with the power system, supplies, and other equipment carried on a drill barge anchored at the platform. (Fig. 4.) Here is Rowland's 1869 patent, which shows just these essentials for marine drilling. The use of drilling mud did not wait for Cap. Lucas and the 1901 Spindletop development. Buckingham's 1890 patent, (Fig. 5) not only talks about drilling fluid but also points out the essentials of oil-base muds, the effective utilization of which is a problem with which many of you are concerned at the present time. Even earlier is Krause's development of 1887 (Fig. 6), which involves drilling and simultaneous acidizing. Nowadays, we are accustomed to associate the name of Nobel with the periodic prizes bearing his name. However, he was just an explosives expert in 1865, when he patented a system of shooting wells with nitroglycerin, (Fig. 7) which is illustrated in this patent, reissued in 1869. It should be mentioned that a reissued patent does not have an additional lease of life, but expires on the same date as did the original patent. (Fig. 8.) Roberts in 1866 issued this patent, which shows the earliest nitroglycerin bomb I have seen.

It was not long after wells first produced that the operators ran onto the problem of paraffin deposits in wells — another problem with which we still tangle. (Fig. 9) Jacob Taylor, of Petroleum Centre, Pennsylvania, patented this paraffin scraper in 1869, which uses a funnel of leather or other pliable material at the end of a pipe to scrape the well walls. Even earlier, Fraser in 1865 patented introducing naphtha, crude oil, or benzene to dissolve paraffin, coupled with the simul-

Down Go Mud Costs...

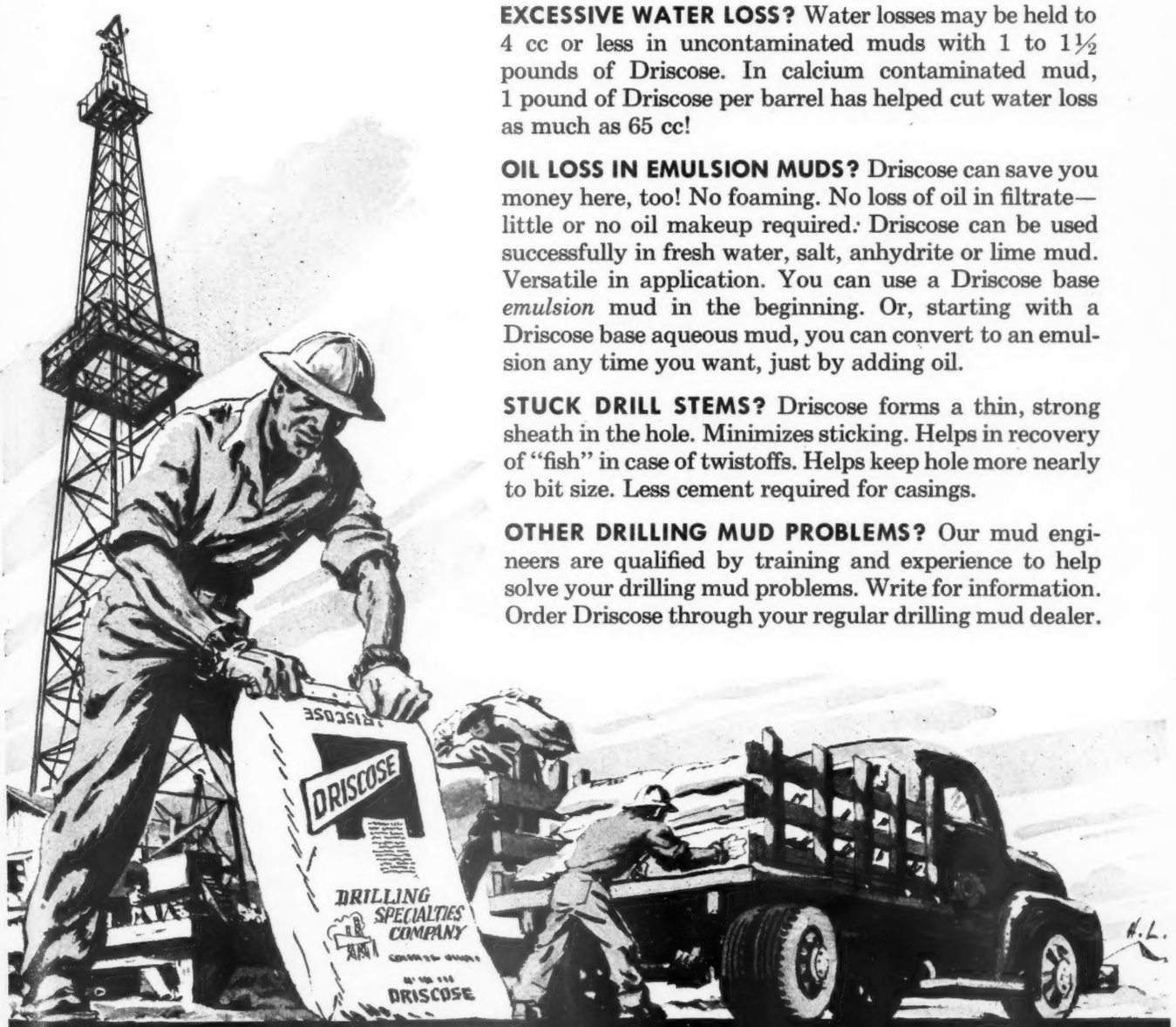
when you drill with DRISCOSE*

EXCESSIVE WATER LOSS? Water losses may be held to 4 cc or less in uncontaminated muds with 1 to 1½ pounds of Driscose. In calcium contaminated mud, 1 pound of Driscose per barrel has helped cut water loss as much as 65 cc!

OIL LOSS IN EMULSION MUDS? Driscose can save you money here, too! No foaming. No loss of oil in filtrate—little or no oil makeup required. Driscose can be used successfully in fresh water, salt, anhydrite or lime mud. Versatile in application. You can use a Driscose base *emulsion* mud in the beginning. Or, starting with a Driscose base aqueous mud, you can convert to an emulsion any time you want, just by adding oil.

STUCK DRILL STEMS? Driscose forms a thin, strong sheath in the hole. Minimizes sticking. Helps in recovery of "fish" in case of twistoffs. Helps keep hole more nearly to bit size. Less cement required for casings.

OTHER DRILLING MUD PROBLEMS? Our mud engineers are qualified by training and experience to help solve your drilling mud problems. Write for information. Order Driscose through your regular drilling mud dealer.



*DRISCOSE is a trademark for Sodium Carboxymethylcellulose

Export Division
30 ROCKEFELLER
NEW YORK

DRILLING SPECIALTIES COMPANY

BARTLESVILLE, OKLAHOMA

L. DOW
Diamond Stone-Drill
51,814 Jan. 2, 1866

Fig. 3

T. F. ROWLAND
Rock Drill
89,794 May 4, 1869

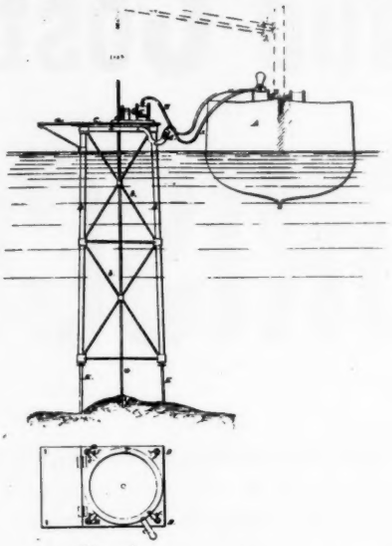


Fig. 4

J. L. BUCKINGHAM
Method of Drilling Rock, etc.
424,266 Mar. 25, 1890

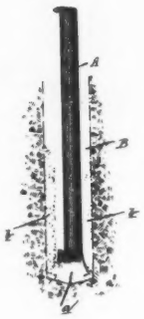


Fig. 5

A. KRAUSE
Method of Drilling Rock
372,154 Oct. 25, 1887

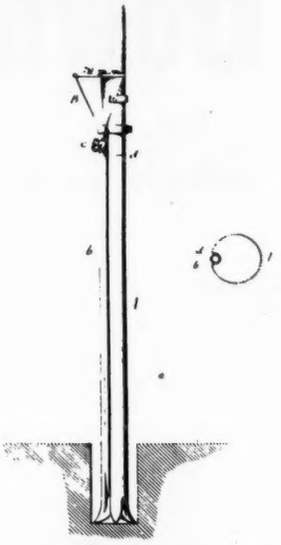


Fig. 6

A. NOBEL
Use of Nitro Glycerine
3,380 April 13, 1869

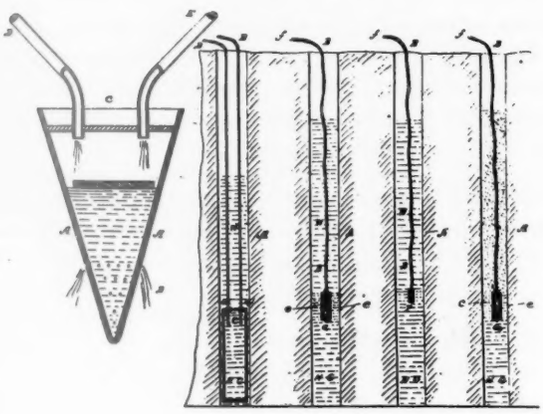


Fig. 7

E. A. L. ROBERTS
Method of, and Means for, Increasing the Capacity of Oil-Wells
5,434 June 3, 1873

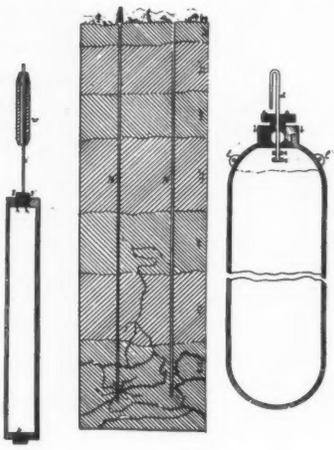


Fig. 8

J. TAYLOR
Oil Well Cleaner
85,622 Jan. 5, 1869

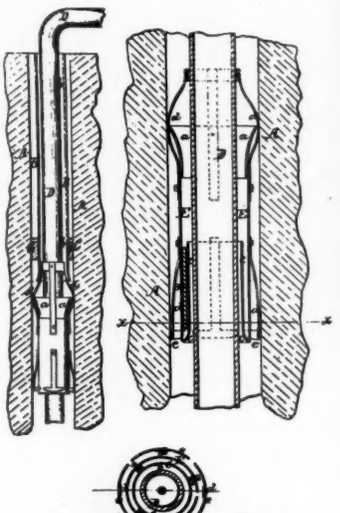


Fig. 9

F. HUOT
Treating Petroleum
71,619 Dec. 3, 1867

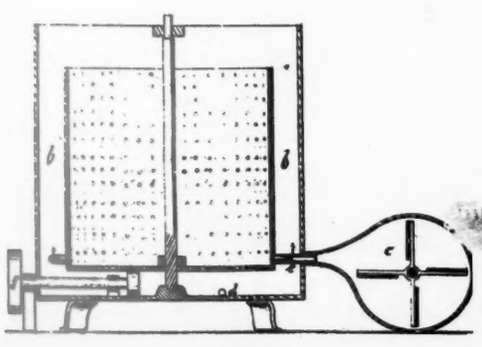


Fig. 10

E. A. VAN SCOY
Device for Removing Paraffine from Oil Well Tubing
232,091 Sept. 7, 1880

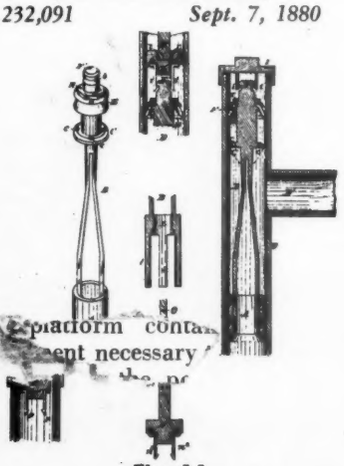


Fig. 11

M. LYTLE
Method of Working Oil-Wells
146,600 Jan. 20, 1874

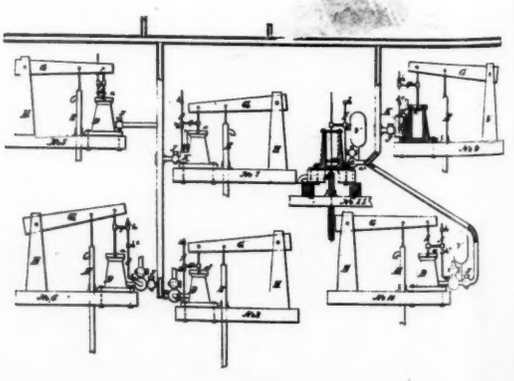
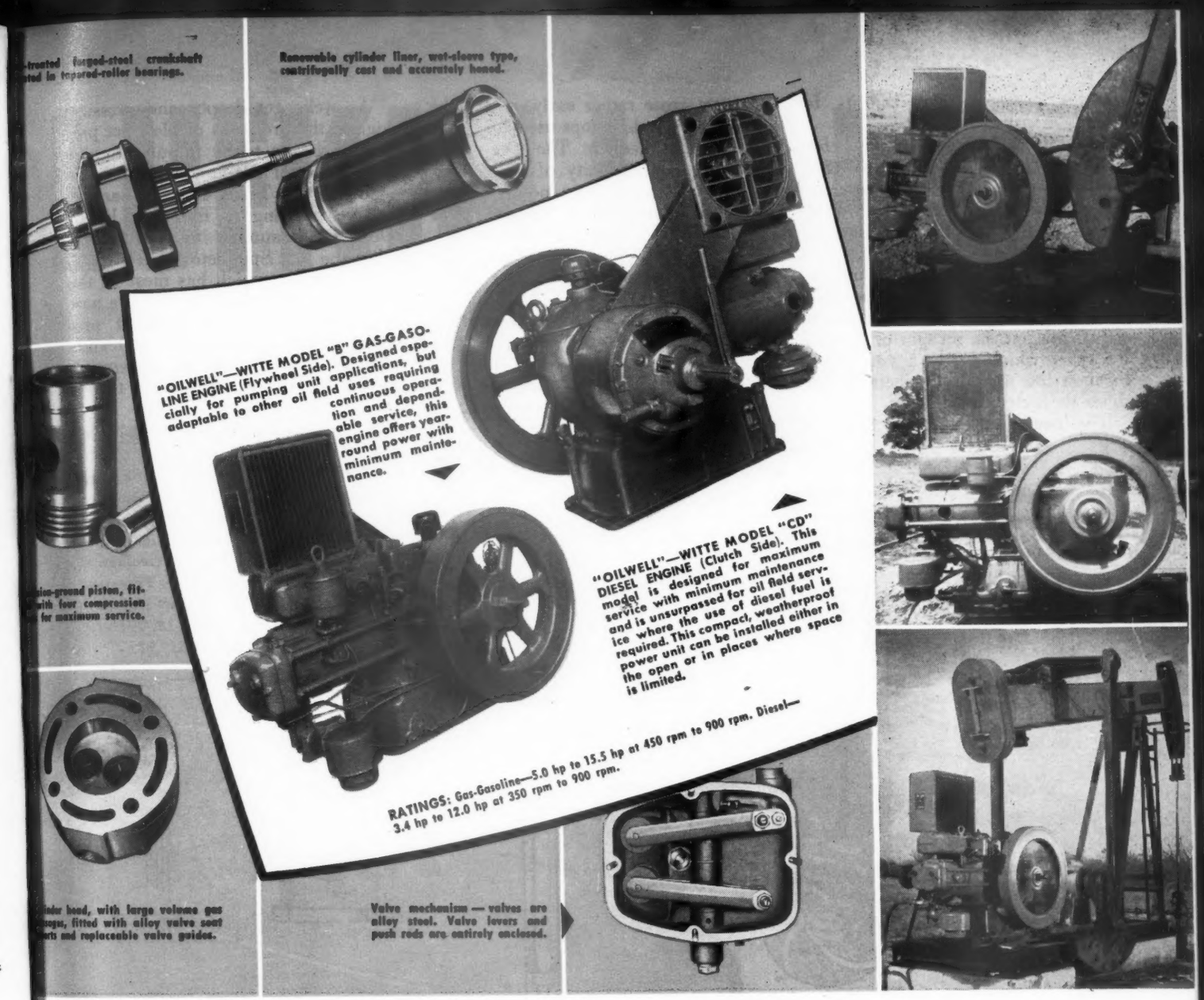


Fig. 12


-treated forged-steel crankshaft ted in tapered-roller bearings.
Removable cylinder liner, wet-sleeve type, centrifugally cast and accurately honed.
"OILWELL"—WITTE MODEL "B" GAS-GASOLINE ENGINE (Flywheel Side). Designed especially for pumping unit applications, but adaptable to other oil field uses requiring continuous operation and dependable service, this engine offers year-round power with minimum maintenance.
"OILWELL"—WITTE MODEL "CD" DIESEL ENGINE (Clutch Side). This model is designed for maximum service with minimum maintenance and is unsurpassed for oil field service where the use of diesel fuel is required. This compact, weatherproof power unit can be installed either in the open or in places where space is limited.
RATINGS: Gas-Gasoline—5.0 hp to 15.5 hp at 450 rpm to 900 rpm. Diesel—3.4 hp to 12.0 hp at 350 rpm to 900 rpm.
ion-ground piston, fit- with four compression for maximum service.
ndar head, with large volume gas ages, fitted with alloy valve seat ts and replaceable valve guides.
Valve mechanism — valves are alloy steel. Valve levers and push rods are entirely enclosed.

Designed to keep 'em pumping!

"Oilwell"-Witte Gas-Gasoline and Diesel Engines

THE "Oilwell"-Witte line of heavy-duty, single-cylinder power units is built for continuous operation over wide range of speeds.

Equal power on natural gas or gasoline
... convertible to cold-start Diesel
... manual starting on all fuels.

Outstanding features which have aided in establishing the fine reputation of "Oilwell"-Witte Horizontal Oil-field Engines include (1) sensitive, easy-to-regulate governor giving immediate speed control, (2) lubricating oil pump and filter, (3) lubricating oil can be replenished without engine shut-down, (4) visible Lucite oil-level gauge, (5) mechanically operated valves, (6) weather-proof Neoprene sleeve type spark plug shield on gas types, (7) condenser-type cooling system, (8) all working parts in weatherproof enclosures, as well as other field-proved features illustrated above.

Check with your nearest "Oilwell" representative and learn ... how perfectly the combination of an "Oilwell" Pumping Unit operates with its companion "Oilwell"-Witte Engine.

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NEW YORK 20, ...

Division Offices — CASPER, WYOMING
COLUMBUS, OHIO ... DALLAS, TEXAS
HOUSTON, TEXAS ... TULSA, OKLAHOMA
LOS ANGELES, CALIFORNIA

USS "OILWELL"

UNITED STATES STEEL

taneous heating of the deposits, for example, with steam.

Two other patents issued before 1870 are Johnson's patent of 1866, which covers a very early separator and the Huot patent of 1867, in which petroleum is weathered to remove the more volatile constituents. (Fig. 10.)

It took a number of years until an automatic-type paraffin scraper was developed, but by 1880 Van Scoy came out with a paraffin scraper of the rabbit type, which made a round trip through the well tubing between the times the well headed. (Fig. 11.)

The matter of pumping wells, of course, arose rather early, and at the start the simple pumps used for water wells were adequate. The idea of operating a multiplicity of wells on a lease from a common power source occurred fairly early, and in 1874 we find Murdick Lytle's hydraulic system for pumping a large number of wells from a common fluid line. (Fig. 12.) The pumping jacks had a crude form of hydraulic counter-balance. Getting the pump down close to the liquid level was not a late development either. A hydraulically actuated deep well pump was patented by C. S. Cox in 1893, (Fig. 13).

As wells got deeper and pressure higher, the problems of blow-out preventers began to be important, particularly after the famous early wells at Beaumont, Texas. It is not particularly surprising to find that Harry Decker of Beaumont invented 2 years after the first Spindletop well a blow-out preventer which has most of the features in a crude form that are now employed in modern blow-out preventers. The rams contain a flexible packing and are split into cooperating halves actuated by oppositely turned screws. (Fig. 14).

All of these patents are illustrative

R. C. BAKER
Guiding, Floating, and Cementing Device for Well Casings
Feb. 18, 1930 1,748,007

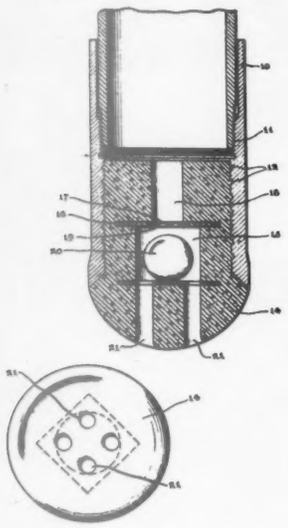


Fig. 19

R. C. BAKER
Cementing Device for Well Casings
April 4, 1939 2,153,034

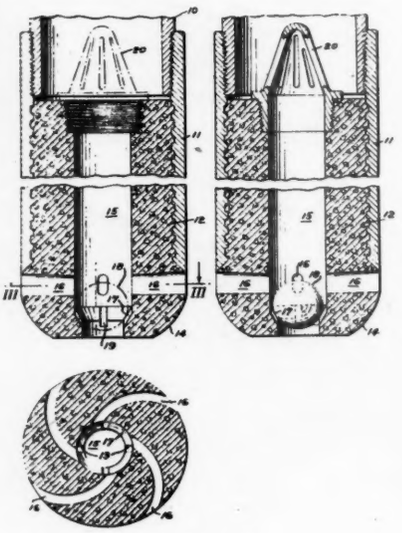


Fig. 20

W. I. BETTIS ET AL
Well Casing Protection
Feb. 16, 1926 1,573,031

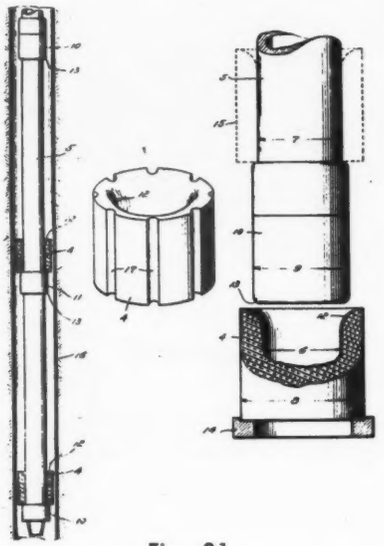


Fig. 21

C. SCHLUMBERGER
Electrical Process and Apparatus for the Determination of the Nature of Geological Formations Traversed by Drill Holes
Aug. 18, 1931
1,819,923

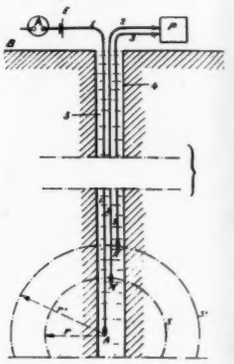


Fig. 22

H. C. EDDY
Method of Removing a Salt from Oil
Sept. 29, 1931 1,825,309

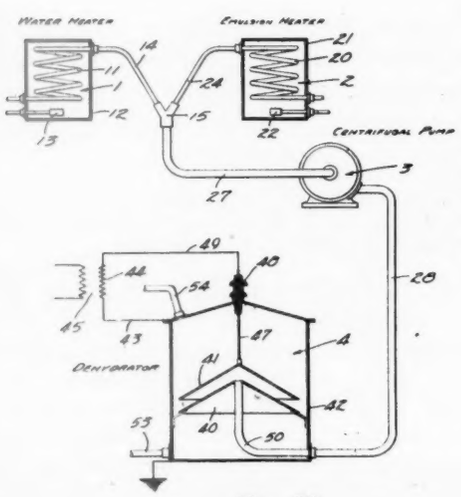


Fig. 23

W. C. TROUT
Counterbalance for Crank Shafts
June 15, 1926 1,588,784

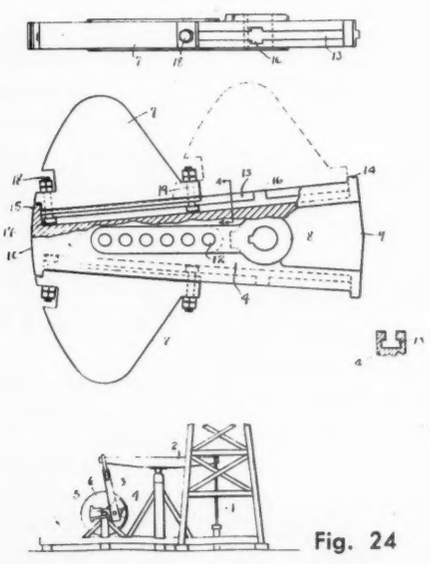


Fig. 24

R. A. FESSENDEN
Method and Apparatus for Locating Ore Bodies
1,240,328 *Sept. 18, 1917*

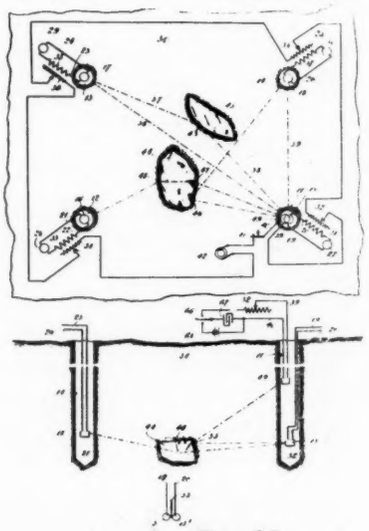


Fig. 25

LUFKIN LEADS!

The TROUT COUNTERBALANCED CRANK was first introduced and adapted to oil field pumping units by LUFKIN in 1923.

One man with perfect safety and without adding or reducing weight elements can change the counterbalance effect by either a few ounces or by hundreds of pounds.

This crank, along with many other patented improvements, have contributed to LUFKIN'S imminent leadership in the industry.

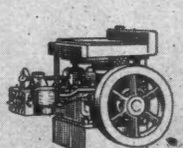
On the smaller Lufkin Units, no tools, other than the wrench furnished with the unit, are necessary to enable one man to change counterbalance as desired.

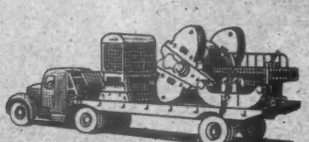
LUFKIN FOUNDRY & MACHINE COMPANY
LUFKIN, TEXAS

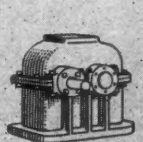
Branch sales and service Houston, Dallas, New York, Tulsa, Los Angeles, Seminole, Oklahoma City, Corpus Christi, Odessa, Kilgore, Wichita Falls, Casper, Wyoming; Great Bend, Kansas.

Lufkin Equipment in CANADA is handled by
THE LUFKIN MACHINE CO., LTD. 14321 108th Avenue, Edmonton, Alberta, Canada

LUFKIN PUMPING UNITS


LUFKIN-COOPER-BESSEMER ENGINES


LUFKIN OIL FIELD AND INDUSTRIAL TRUCK TRAILERS


INDUSTRIAL SPEED REDUCERS AND INCREASERS

DIVISION LUFKIN FOUNDRY & MACHINE COMPANY INDUSTRIAL, MILL AND AUTOMOTIVE SUPPLIES

C. S. COX
Pump
500,856 July 4, 1893

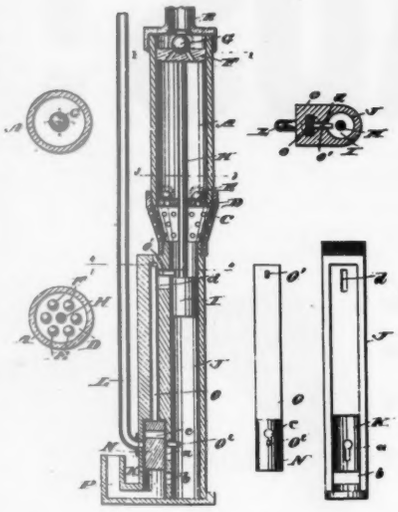


Fig. 13

H. R. DECKER
Oil Well Drill
732,925 July 7, 1903

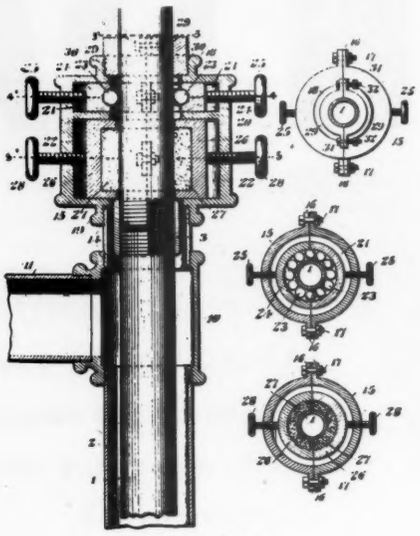


Fig. 14

H. R. HUGHES
Drill
930,759 Aug. 10, 1909

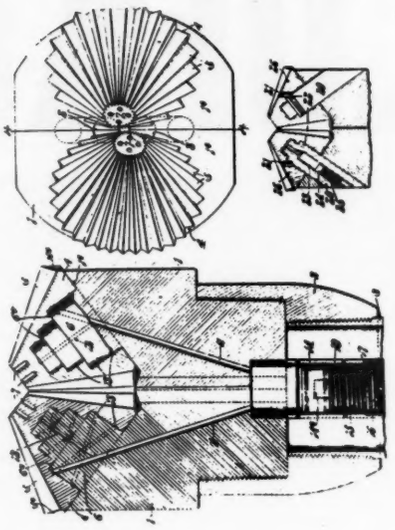


Fig. 15

of the patent attorney's frequent complaint that there is nothing new under the sun. They illustrate more strongly the fact that most of the basic tools of the equipment and petroleum engineer are available without royalty or encumbrance of any kind, unless the engineer wants the most modern improvements. Basically, he is free to operate.

The other point that I mentioned about the effect of patents in the producing and exploration end of the oil industry was their place in building up small service and equipment companies to the point where they could give effective aid to the constantly growing demands of the oil industry. One early example of that is that comes to mind is the Hughes patent on the double-cone bit, (Fig. 15) which was patented in 1909. Certainly, it is true that there were many factors besides the issuance of patents which assisted the growth of the Hughes Tool Company to its present size. The point I wish to make is that during the period shortly after the issuance of the patent this particular patent very effectively assisted the Hughes Tool Company in establishing an excellent competitive position in the then small oil-tool business.

The California Cementing Company found that their Perkins and Double patent (Fig. 16) on the two-plug system of placing cement in a well was also a considerable factor in their growth. Later on, the Halliburton Oil Well Cementing Company was similarly able to assume a commanding position in the industry due in part to this patent and patents (Fig. 17) on the jet mixer, which enabled cement to be mixed before placement in a fraction of the time previously necessary.

The rapid development of gun perforating was protected by the Mims patent of 1926 (Fig. 18), which covered the first successful development

A. A. PERKINS & E. DOUBLE
Method of Cementing Oil Wells
1,011,484 Dec. 12, 1911

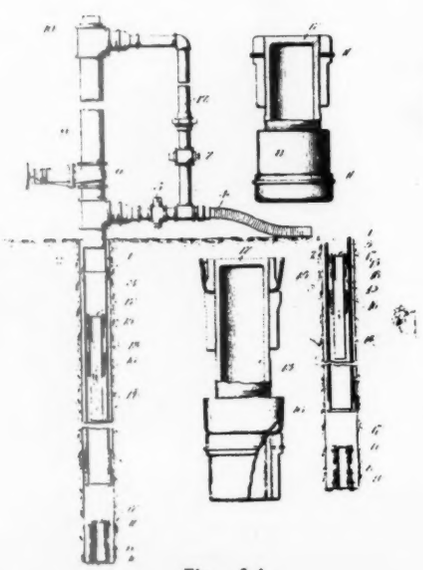


Fig. 16

E. P. HALLIBURTON
Method of Hydrating Cement and the Like
March 18, 1924 1,486,883

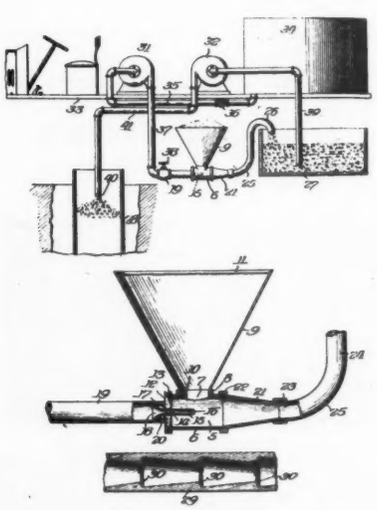


Fig. 17

S. W. MIMS
Method and Means for Perforating Well Casings
April 27, 1926 1,582,184

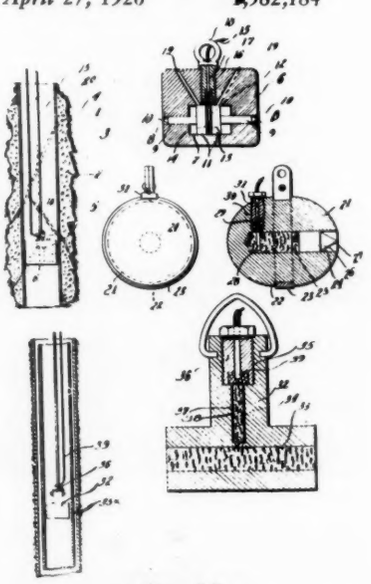
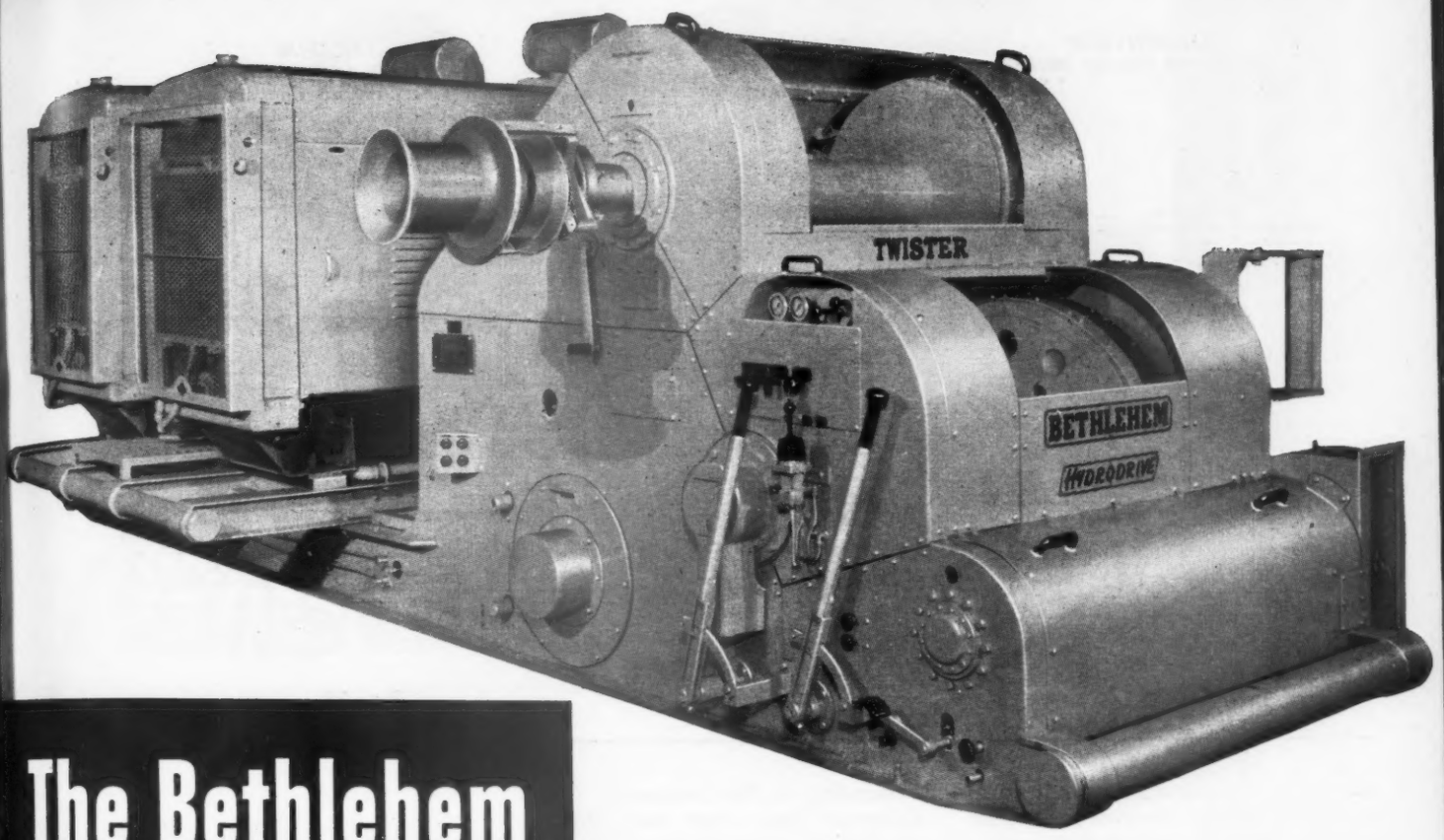
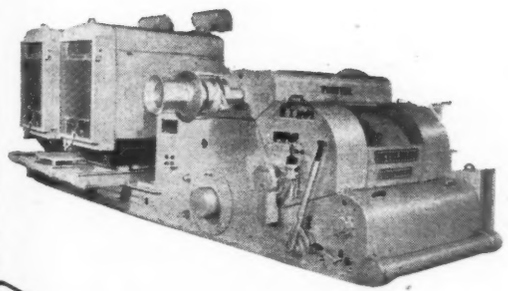
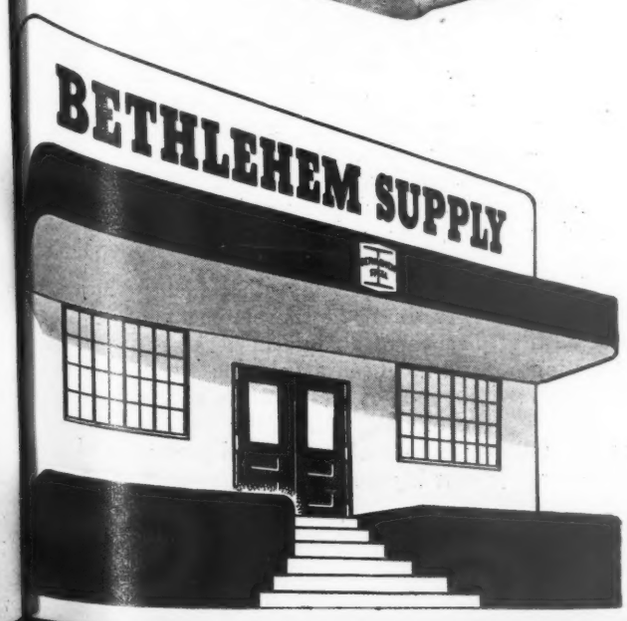


Fig. 18



The Bethlehem TWISTER makes shock-loading obsolete





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L. MINTROP
Geological Testing Method
Sept. 14, 1926 *1,599,538*

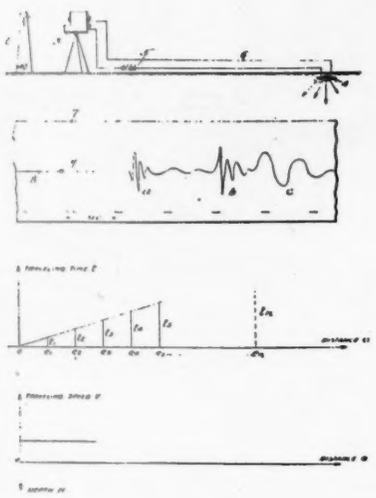

Fig. 26

B. McCOLLUM
Method and Apparatus for Studying Geologic Contours
July 10, 1928 *1,676,619*

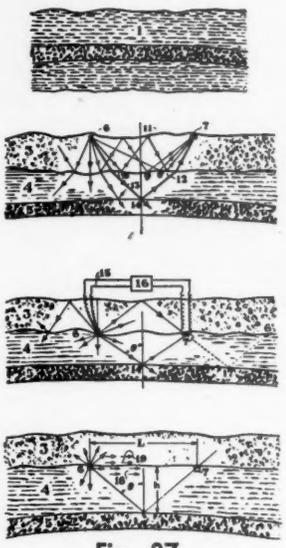

Fig. 27

B. McCOLLUM
Method and Apparatus for Studying Geologic Contours
June 26, 1928 *1,675,121*

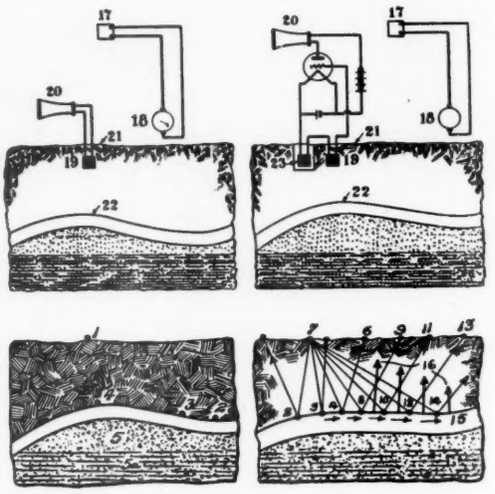

Fig. 28

of explosive perforating using a form of bullet. Equally effective in its field was the Baker patent of 1930, (Fig. 19) on a float shoe that could easily be drilled after using. Another advance in this field was Baker's 1939 patent on the whirler float shoe. (Fig. 20).

Drill pipe and casing protectors are very common today, but in 1926, when the Bettis and Perry patent (Fig. 21) was issued, the situation was quite different. It was such a simple device that the development could have been extensively hampered by pirating the design. This the patent prevented. Of course, this invention is now in the public domain.

Another effective aid in the development of a major service company was a series of patents to Conrad and Marcel Schlumberger, of which that of August 1931 (Fig. 22) was probably the most important. Petreco was similarly protected by their Eddy patent of 1931 (Fig. 23) in developing a good business position in the electrical desalting of crude oil.

Still another of these early patents, (Fig. 24) the Trout patent of 1926, was of material assistance to the Lufkin Company in their development of adjustable counterbalances for pumping units.

Many more examples could be given of similar developments in other companies which are now very well known in the industry. These were selected at random to illustrate this point.

With reference to the exploration end of the petroleum industry, the situation has been about the same. Fessenden, of the Submarine Signal Company, was a very early inventor in the seismic field, his work being largely based on the detection of enemy submarines during the first World War. He realized that sound waves could be used for earth prospecting; and, a long time before seismic exploration was carried out, he issued a patent (Fig. 25) which entered public domain as early as 1934. Probably the first patent in the geophysical-prospecting field that proved important to its owners from a financial standpoint was Mintrop's 1926 patent (Fig. 26). Using this system, Mintrop and his associates made an extremely valuable group of discoveries that in time-rate has not been exceeded to the present. This and a large group of patents were purchased by a major oil company, which made them available to the entire industry on what proved to be quite reasonable royalty terms in the long run. Another of this group of patents was the McCollum patent of 1928, (Fig. 27), which is probably the first patent recognizing the now popular system of reflection prospecting. Most of these early patents have likewise expired, facilitating the free use of the inventions. Recently, considerable interest has been shown in airblast shooting, in which the explosive is detonated above the surface of the earth, thus eliminating the expensive process of drilling shot holes at each location. (Fig. 28). It is interesting to see that McCollum in 1928 also recognized this principle.

In geophysical prospecting, it is very customary practice for the independent companies and the geophysical branches of the oil companies to work relatively unhampered, by the recognition of the principle that more is to be gained from reasonable licensing (or from cross-licensing when there are patents held on both sides) than from the exclusive use of the invention by the particular owner.

It would be impossible in a brief review of this sort to cover any part of the field in detail. I believe that the illustrations given amply bear out the two factors which I believe are of basic importance in the influence of the patent system on the production and exploration end of the oil industry. In the first place, patents have been available as a protection in developing industries, so that, by the end of the useful life of the patent, equipment companies, manufacturers, and service companies have been aided to a sound financial footing, able to assist in the effective discovery and efficient recovery of oil and gas. In the second place, the work of the pioneer patentees in each phase of the industry has by the passage of time made free to the industry the major developments so that effective competition could exist in each of these developments. The patent system can never be a substitute for sound business judgment, effective financing, or any other factor which goes into the development of one branch of an industry. But it can be and has been a valuable asset in aiding each of these factors and perhaps, beyond all, in assisting you engineers in the development and protection of your ingenuity. ★ ★ ★

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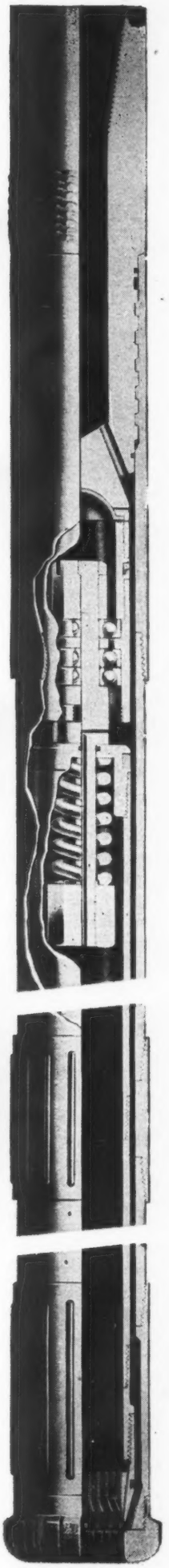

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ECONOMIC SIGNIFICANCE

Secondary Operations and Reserves in the Eastern States

PAUL J. TORREY*

THE business of producing oil is such an important factor in the economic life of the nation that the efficient operation of oil fields has direct bearing on maintaining and extending prosperity in every state so fortunate to have been endowed with oil resources. All measures that may be taken to maintain profitable production of oil, therefore, are deserving of considerate support by the governments and by the people of the oil-producing states. Such measures may be designed to secure from older fields the recovery of oil that will not be obtained by the methods of production that have been employed, or they may serve to assure the maximum economic recovery of oil from recently discovered fields and from fields yet to be discovered.

Methods for increasing the recovery of oil were first developed and applied extensively in the eastern states. Although well known and outstanding results have been obtained, significant and imposing opportunities still exist in this region for obtaining more oil from presently known and developed fields. Proper utilization of these opportunities, very conceivably, can have a profound influence on the future economic life of communities as well as of commonwealths. As a matter of fact, the future of many communities is so closely associated with the preservation of the oil industry that for all practical purposes they may be considered to be inseparable.

The development and application of secondary techniques in the Penn Grade area have been described ably and adequately at previous meetings of the Interstate Oil Compact Commission, particularly by Don T. Andrus[1] at the 1946 summer meeting, held at Grand Rapids, Michigan, and, similarly but more recently by J. P. Jones[2] in testimony before the Armed Service Subcommittee of the House of Representatives of the United States. The details of these discussions have received wide and highly deserved publicity, and need not be repeated. For that reason, principal attention can be devoted without extensive preamble to important recent events in the history of the oil industry in the interior states of the Eastern area, and particularly to recent developments in Illinois.

Oil was first discovered in Illinois in 1889, and by 1904 and in immediately succeeding years the fields of southeastern Illinois became one of the important oil-producing regions of the United States. Illinois ranked third in the nation's production in 1908, 1909, and 1910. Thereafter, oil production declined continuously until the discovery and rapid development of new fields in southern Illinois, beginning in 1937, served to focus attention again on the oil possibilities of the state.

The more recent oil activity in Illinois was preceded by the notable discovery in 1928 of the Mt. Pleasant field, situated in the central part of the Michigan basin. Finding substantial new oil reserves in an area covered by a thick mantle of glacial drift, which prevents surface exploration for geologic conditions favorable for the accumulation of oil and gas, served to renew the attention of the oil industry to the production possibilities of similar areas in other eastern states that formerly had been sparingly explored. The Illinois basin, covered in large part, as it is, by glacial drift, immediately offered promising possibilities for the application of geophysical methods of exploration which contemporaneously were in process of development and refinement. The initial results of geophysical exploration, combined with subsurface studies of the Illinois Geological Survey, were conspicuously successful. During the early part of 1937 the Patoka, Clay City, and Cisne fields were discovered in rapid succession. Later in 1937 the very important Louden field was discovered, and in the following year the Salem field was brought into production. Thereafter, development of the Illinois fields proceeded at an almost unprecedented rate, as a result of the relatively shallow depth of the producing formations and because of the easy drilling conditions. The all-time peak of oil production in Illinois was reached in 1940 with a total of 147,647,000 bbl, which amounted to 10.8 per cent of the total production of the United States, and which advanced Illinois to fourth ranking place among the oil-producing states, it being exceeded only by Texas, California, and Oklahoma. These figures compare impressively with the production during 1937, which amounted to only 7,326,000 bbl of oil, and which represented only 0.57 per cent of the total United States production. Such a phenomenal increase in production has rarely been equalled in the history of the American oil industry. It resulted, as many people will recollect, in a severe dislocation of previously established markets for the crude oil produced from certain of the other states.

Some salient facts regarding the statistical position of the Illinois oil industry, and how it has compared with the oil industry in the other eastern states, are presented in Table No. 1. From Table No. 1, the dominating position of Illinois can be ascertained. Illinois has produced more oil than any of the other eastern states (Column 5); during the past 10 years Illinois has produced more oil than the combined production of all of the other eastern states (Column 9): this

*Chairman, Secondary Recovery Advisory Committee, Interstate Oil Compact Commission, Houston, Texas.

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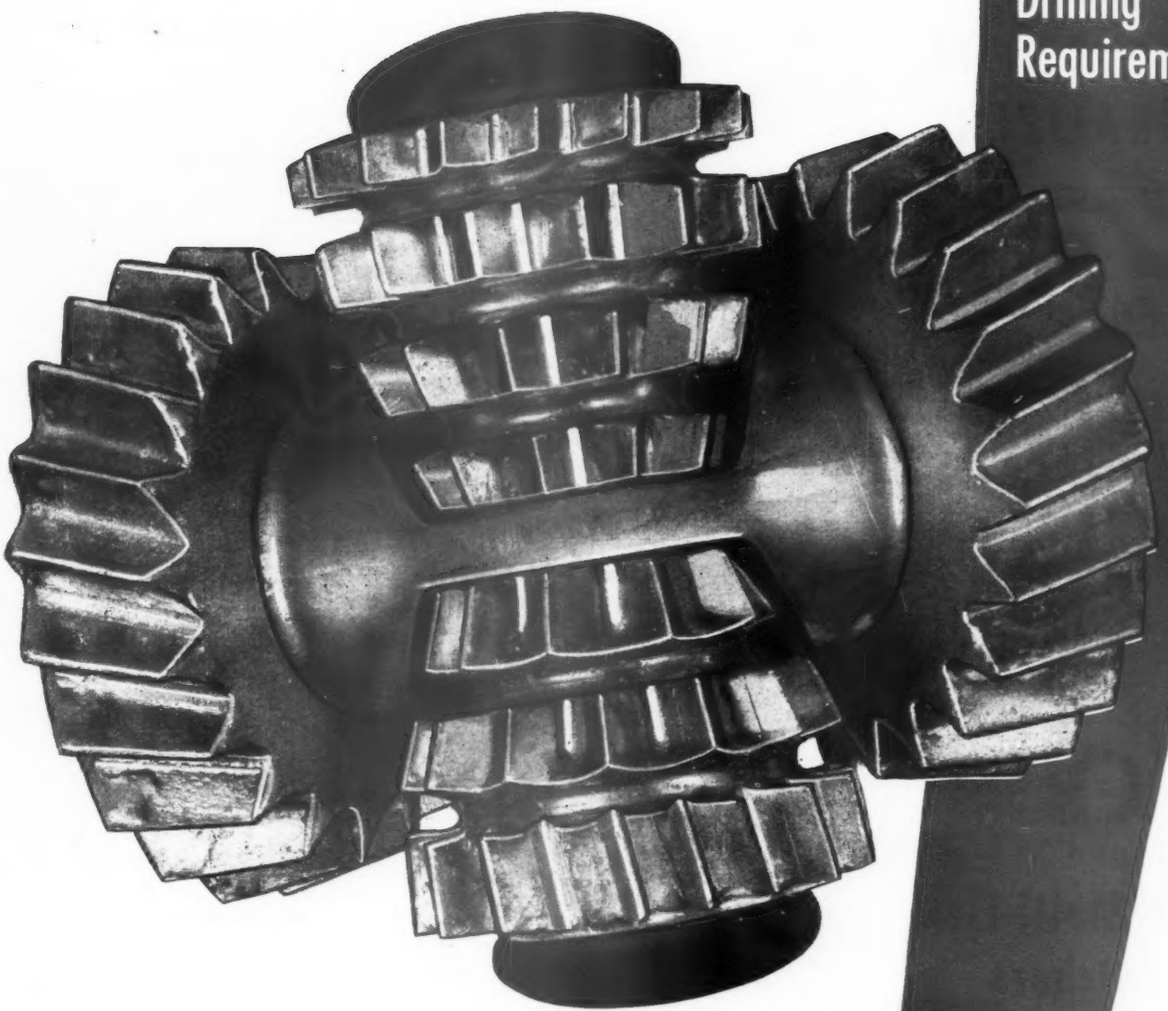

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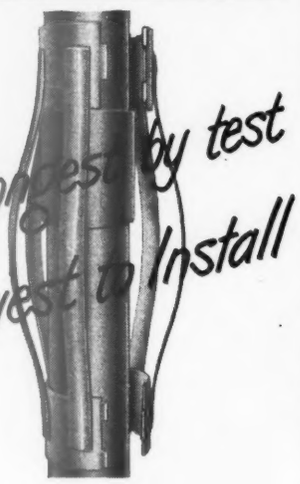

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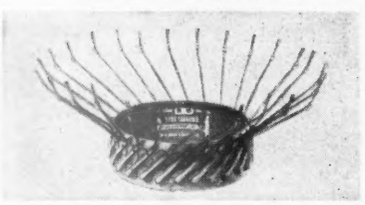

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Table No. 1. Pertinent oil statistics for the eastern states.

All production figures in thousands of barrels

1	2	3	4	5	6	7	8	9	10	11
State	Year of oil discovery	Year of peak production	Production during peak year	Total production to end of 1949	Extensions and revisions 1940–1949	New discoveries 1940–1949	Total of columns 6 and 7	Total production 1940–1949	Production 1949	Proven reserves at end of 1949
Illinois.....	1889	1940	147,647	1,444,300	848,167	129,779	977,946	891,444	63,952	468,138
Indiana.....	1889	1904	11,339	189,565	78,889	21,841	100,730	64,685	9,472	50,209
Kentucky.....	1883	1946	10,578	241,433	74,925	17,906	92,831	80,749	9,456	56,168
Michigan.....	1925	1939	23,462	306,281	126,198	70,415	196,613	181,195	16,547	66,496
New York.....	1864	1882	6,685	172,328	75,788*	0	75,788	48,280	4,216	62,900
Ohio.....	1876	1896	23,941	617,259	21,407	8,272	29,679	33,668	3,485	27,703
Pennsylvania..	1859	1891	31,424	1,113,167	64,813*	0	64,813	144,580	11,450	103,356
West Virginia..	1876	1900	16,196	438,138	20,800	2,225	23,025	30,921	2,830	37,992
Total.....				4,522,971	1,310,987	250,438	1,561,425	1,475,522	121,408	872,962

† (2), (3), (4), and (5) from IPAA "The Oil Producing Industry in Your State."
(6), (7), (9), (10), and (11) from API Reserve Committee 1949 Report.
* All from secondary recovery operations.

superiority was maintained in 1949 (Column 10); and the API proved reserves for Illinois are greater than the combined reserves of all of the other eastern states (Column 11). In 1949 Illinois was the sixth ranking oil-producing state of the nation, being exceeded only by Texas, California, Louisiana, Oklahoma, and Kansas. For these pertinent and compelling reasons, much of the following discussion will be restricted to the opportunies and to the incentives which exist for increasing the recovery of oil from Illinois fields.

Referring again to Table No. 1, it will be immediately apparent that production of oil during the past 10 years in the four states of the Penn Grade Crude area—New York, Pennsylvania, Ohio, and West Virginia—has far exceeded the discovery and development of new reserves. For the Eastern Interior states of Michigan, Indiana, Illinois, and Kentucky, slightly more oil has been found during this period than has been produced, the ratio of discovery to production being 1.12 to 1. However, it should be noted that the favorable position indicated by this ratio is due principally to the spectacular production developed during this period in southern Illinois and southwestern Indiana, and to the fact that in 1949 large secondary reserves were recognized for the first time in Illinois by the API reserve committee. Otherwise, the discovery-production ratio for the Eastern Interior states from 1940 to 1949 inclusive, and for the year 1949 individually, would definitely be below "1", as it has been in the Penn Grade crude area states for several decades.

At the 1948 summer meeting of the Interstate Oil Compact Commission, the writer[3] explained to Chairman Beauford Jester and to the executive committee that discovery-production ratios provide a useful and valuable measurement of the future productive possibilities of the various oil states. It was emphasized in the special report presented at this meeting that in states where production almost equals or is in excess of discoveries over a period of several years, the preservation of the oil industry and its important contributions to the economic and social life of the state and its people will be dependent on the adoption of measures for increasing the recovery of oil from existing fields. The data presented in this report indicated clearly that the oil industry in the four Eastern Interior states was rapidly approaching a deficient position. The more recent and more complete data presented in Table No. 1 shows that the indicated trend that was emphasized at New York almost two years ago has not been arrested. As a matter of fact, the prospects in these states for discovering large new reserves of oil in deeper and older formations remain just as uncertain or even more so at the present time as they were at the end of 1947. Such being the case, it seems appropriate again to urge emphatically that the adoption of measures for maintaining or even increasing the production of oil from discovered reserves, as the occasion may demand for emergency requirements, should certainly be receiving attention by the governments of the respective states, by landowners, and by labor organizations, as well as by the oil industry alone.

The statistical data presented in Table No. 1 show conclusively the increasing difficulty that is being experienced in finding new oil reserves in the eastern states. They do not show, however, the greatly increased expenditures that are being required to find new oil reserves. At the time when the Louden and the Salem fields were found and were being developed, expert economists estimated that 19.2 per cent of the revenue derived from oil production was required for exploration purposes to maintain the discovery of oil in balance with the production of oil. Today that figure

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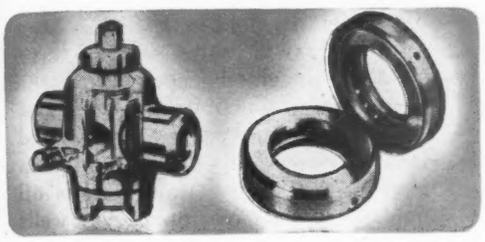

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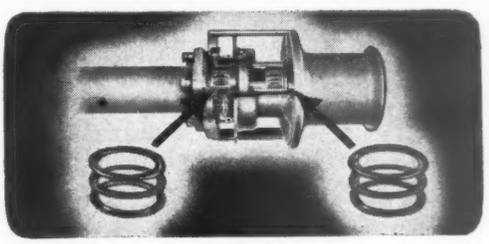

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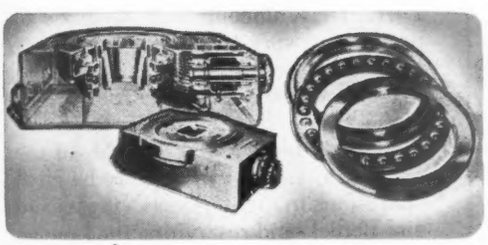

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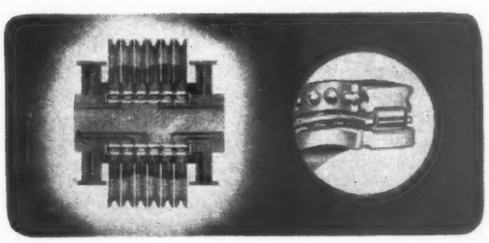

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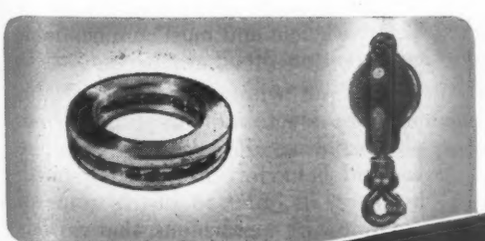

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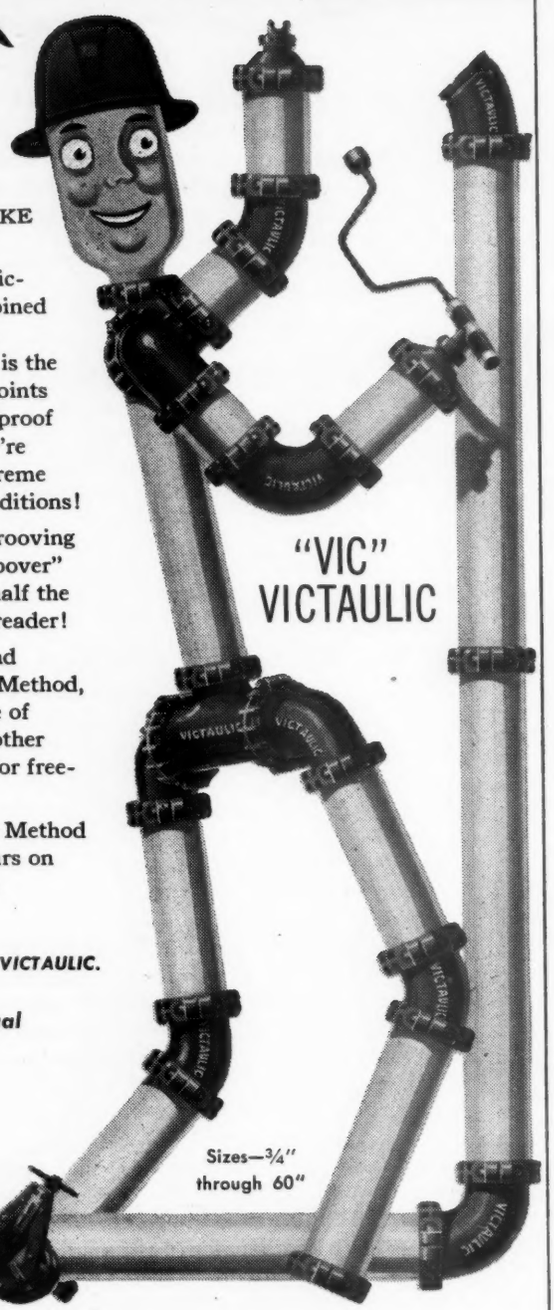

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has increased to about 35 per cent, and there is no indication that continued increase will not take place in coming years. The incentive, therefore, to obtain additional recovery from known reserves of oil rather than to try to find new reserves becomes more and more attractive.

As Illinois has no law for the proration of oil production, which would help to insure that development and production practice will conform best with specific reservoir conditions for each field, a large part of the oil that has been produced since the discovery of the Patoka field in 1937 has been at withdrawal rates which have equalled or closely approached the maximum productivity of the fields. Much unfavorable publicity resulted from the operating conditions which have prevailed in certain Illinois oil fields. An excessive number of wells were drilled in parts of the Salem field and in town-lot areas of the Centralia and Patoka fields, and there was a flagrant waste of gas, with accompanying dissipation of reservoir energy, in the Centralia, Salem, Clay City, Storms, and other areas. Even a cursory observation of production conditions that prevailed during the early life of these fields could not have helped but have created an impression of general overproduction and waste. Fortunately, uncontrolled methods of production were not employed in every field, and there are several outstanding examples in Illinois where rigid conservation practices have been enforced by the voluntary action of the operators, among which may be cited operations in the Louden Cypress sand and Bethel sand reservoirs, the Louden Devonian Lime reservoir, the Dix Bethel sand reservoir, and the Mount Vernon Waltersburg sand reservoir. In these fields development and production practice have been designed with the objective of obtaining the maximum economic recovery of oil rather than the most rapid daily production and depletion. In Illinois, therefore, there are contrasting examples of deplorable waste and poor management of oil resources and of highly efficient and most commendable conservation of oil resources.

It is not within the scope of this paper to devote consideration to complex problems of oil reservoir mechanics and behavior. It must be stated, however, in order to justify some of the following conclusions, that various fields in Illinois, undoubtedly, would have benefited from superior natural water-drive recovery performance, if production had been curtailed to a rate which would have approximated the encroachment of water into the

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reservoir as oil was withdrawn. As the production of such fields was not regulated to conform to the influx of water into their reservoirs, they have yielded oil largely by the action of dissolved gas-drive, the most inefficient natural production mechanism known. In fields where this wasteful mechanism has had a predominate part in the primary recovery of oil, large quantities of oil remain which can now be obtained only by the application of secondary methods.

Squires, Luckhardt, and Bell,[4] in their outstanding contribution to the Second Edition of the Book on "Secondary Recovery of Oil in the United States," state that the oil productive area of Illinois covers 371,000 acres of which only 25,400 acres, or 7 per cent of the total area, have been affected, in varying degree of intensity, by secondary recovery operations. They report that air and gas drive was first attempted in 1921 and has been applied subsequently on some 18,000 acres with an average recovery to date of 260 bbl of oil per acre. Much higher recoveries have been obtained from some of the better designed and more systemative operations, such as the secondary operations in the Colmar-Plymouth field of Hancock and McDonough counties, from which a recovery of some 870 bbl of oil per acre has been obtained over a period of 11 years.

Results obtained from more recently commenced water-flooding operations are much more impressive. Accidental and haphazard waterfloods were in operation in various fields of southern Illinois as far back as 1924, but more systematic and controlled projects, patterned after modern practice as developed in the oil fields of New York and Pennsylvania, were not commenced until 1943 when a pilot flood in the Patoka field was placed in operation. This project later was expanded to cover an area of over 500 acres from which a secondary recovery of over 10,000 bbl of oil per acre has already been obtained in comparison to a previous unaided primary recovery of about 5000 bbl of oil per acre.

Information taken from a recent paper by Vincent and Huffman[5] on 11 Illinois water-flooding projects, where estimations of secondary recovery have been made, indicate that an average secondary recovery of about 5200 bbl of oil per acre can be expected, in comparison to an average primary recovery of slightly over 3100 bbl of oil per acre. Secondary recovery operations in Illinois, therefore, which are expected to more than double the primary recovery of oil, cannot be regarded as new and untried experiments. The oustanding results speak for themselves.

If the application of secondary methods in Illinois should result in an average increase in oil recovery of only 1000 bbl per acre for the entire productive area of the state, which certainly does not appear to be an unreasonable presumption if consideration is given to the results obtained from existing secondary operations, the ultimate primary recovery of the state will be increased by some 371,000,000 bbl. The proven reserve of Illinois at the end of 1949, as estimated by the American Petroleum Institute, amounts to 468,138,000 bbl, of which it is known that 134,000,000 bbl are attributed to secondary recovery projects now in operation. In consequence, the primary reserve of the state actually amounts to 334,138,000 bbl of oil. From these figures it is easy to determine that the minimum secondary reserve, as estimated in this paper, after liberal allowance for all previous secondary production, is in the range of 350,000,000 bbl of oil and therefore, exceeds the proven primary reserve. This figure, undoubtedly, is conservative, for it is well known that effective secondary waterflooding operations usually can be anticipated to double the primary recov-

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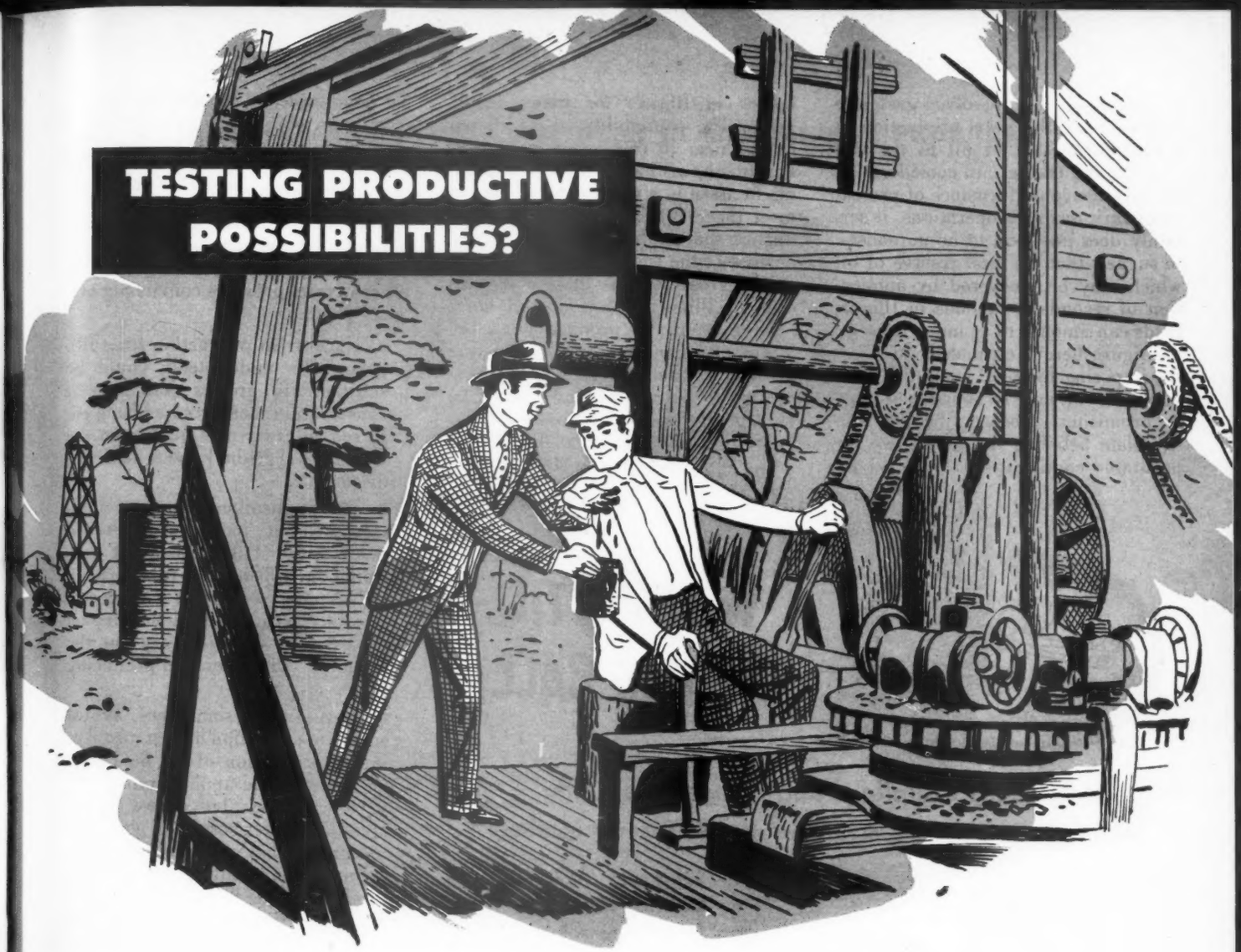

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ery obtained from dissolved gas-drive reservoirs. With a total production of 1,444,300,000 bbl of oil to the end of 1949 and taking into consideration the impressive performance of present secondary recovery operations, it certainly does not seem to be unrealistic to suggest that the total reserve of oil which may be recovered by application of secondary methods in Illinois fields can amount to as much as twice the figure herein estimated. At least, the imposing figure of some 700,000,000 bbl of oil may be considered to be a promising prospect, which can stimulate belief in the possibility for profitable continuation of the oil industry in Illinois for many future years. The availability of additional oil, so near to centers of large consumption of petroleum products, might assist in a most material way to meet the demand for expanded production that might be required for the defense of the United States.

The gross revenue that should accrue to Illinois operators and landowners from the production of the minimum secondary reserve, using the 1949 average price of $2.77 per barrel, is calculated as follows:

To Operators—Gross Income

350,000,000 × 2.77 × 0.875

equals $848,312,500

To Land-owners—Royalty Income

350,000,000 × 2.77 × 0.125

equals $121,187,500

Total $969,500,000

The notable results that have been obtained by the maintenance or restoration of pressure in various Illinois oil reservoirs provides convincing evidence that:

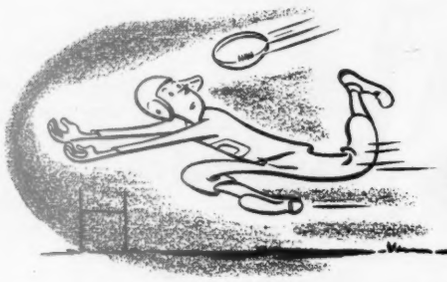
a. The current production from Illinois fields undoubtedly could be substantially greater than it is if conservation measures had been enforced in every new field from the very time that the Patoka field was discovered.

b. The application of conservation measures to recently discovered fields in the Illinois basin not only would have benefited substantially the ultimate recovery of oil, but also it would have lessened the impact of a major oil discovery on the economy of other oil-producing states.

c. Partial and sometimes almost complete correction of past mistakes in the production of oil fields can be made by the application of secondary methods, but almost always at much greater cost. It is generally recognized that maintenance of reservoir pressure and a fairly uniform production rate is preferable and is more effective than pressure restoration at or near the end of the primary production phase.

It must be appreciated that the application of secondary methods is limited, just as primary production is limited, by the ability to produce oil at a profit. Profitable secondary recovery can be assured in many fields only by means of unit or cooperative operations. For this reason, the action taken by the Interstate Oil Compact Commission in encouraging its member states to revise laws or to enact new laws which will permit the application of the most efficient oil recovery techniques by means of unit operations is commended highly. This outstanding contribution by the Compact can have an important bearing on the future success of many secondary recovery projects.

The possibilities for the more efficient and more economic recovery of oil by the operation of fields as units have been recognized for many years. The basis for this recognition originally was founded on the impressive record of effective and low-cost recovery that has been obtained from various foreign fields and from some domestic fields which have been developed and operated by one company. In most foreign countries, where



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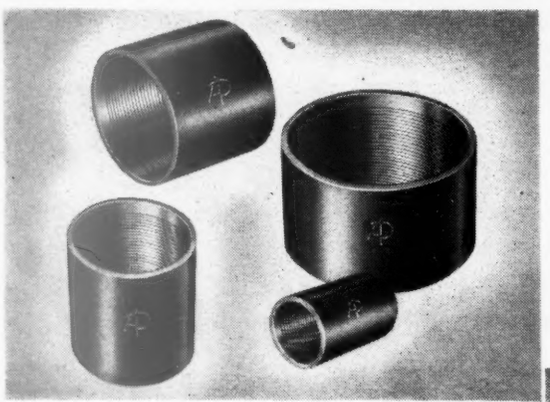

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private ownership of mineral rights is not allowed, frequently one lease or concession will encompass the entire productive area of an oil field. The location of wells and the production of oil therefore, may be designed expressly to conform best to existing reservoir conditions, and without any consideration of variable fee or lease ownership.

Excepting reservoirs that possess uniformly low or very irregular permeability the maximum recovery of oil may not be obtained necessarily by production from densely spaced wells located on every property within the defined limits of a field. More frequently operating experience has indicated, the maximum economic recovery can be obtained by operations in which the movement of fluids through the reservoir is forced to wells that have been selected as producers without regard to their location with reference to established property lines. The selection of the most suitable wells for production purposes is based on extensive study of the original occurrence of fluids in the reservoir, and on studies of readjustments that may take place in the reservoir as oil is withdrawn, or which may be caused by gas or water injection into the reservoir. As a consequence, increased ultimate recovery may be obtained by purposely forcing an underground migration of fluids from one property to another, and by restricting or denying the right to produce oil on one property to the determinable advantage of adjoining properties. Obviously, the only fair and equitable manner by which such operations can be conducted is for the operators and the land-owners, with the approval of the state regulatory authority, to agree on a plan for the exploitation of a field which will insure each party his proportionate share of all of the oil produced. The unitization of the field is a method whereby such an agreement can be effected. For that reason, if for no other, it should be emphasized that unit agreements and unit operations provide a method whereby both the operator and the landowner can protect and enjoy their proportionate participation in a field, and at the same time promote the adoption of measures designed to insure the maximum economic recovery of oil, which will further enhance the value of their respective equity interests.

The frequent misunderstanding that unit agreements are to be imposed by law or regulation so as to deprive a minority operator or royalty-owner of his equity requires affirmative correction. Every effort should be made to show the legislatures and executives of the various states, as well as the parties directly interested in the production of oil from a specific field, that a unit agreement is not a means to deprive any individual of his right to an equitable share of the produced oil. Rather, a unit agreement provides an effective method whereby each party can safeguard and preserve that which belongs to him. Furthermore, the contention that unit operations constitute restraint of trade and, thereby, violate antitrust laws is nonsense, and can only be based upon fallacious reasoning that independent operators and landowners do not possess the right to profit to the maximum extent from the resources belonging to them, while, at the same time they serve, unquestionably, the public interest by the more prudent and effective exploitation of their property.

It should be evident that substantial economies in development and operating cost may result from unit operations. These economies are important both to the operator and to the royalty-owner for they can enable the exploitation of deep or inferior reservoirs, and they can permit a continuation of oil production down to a very low level. However, the primary advantage of unit operations result from increased ultimate recovery and this fact should not be confused with other less relevant arguments.

Shortly after oil was discovered in Pennsylvania in 1859, it was recognized that the removal of fluids from underground reservoirs created differentials in pressure that would cause movement of oil, gas, or water from one point to another in the reservoir. The injection of fluids into reservoirs creates similar pressure differentials that will cause both the reservoir fluid and the injected fluid to move through the permeable rock. The ability to control such movement of fluids and to use the same to the maximum advantage will determine, in many cases, the success or failure of a secondary project. Failure can easily result if the fluid injection program is not planned to conform to lack of homogeneity in the permeability profile, to any existing discontinuity in the reservoir, and to changes in the relative permeability of the reservoir rock to various fluids that takes place as fluids are removed. It should be obvious that one operator or several operators cannot restore pressure effectively in a common permeable reservoir as long as another operator may persist in the destruction of pressure effects as rapidly as they are created. Furthermore, no method is known whereby underground barriers can be created to prevent the destruction of pressure effects by an uncooperative neighbor. Consequently, almost every reason can be advanced for the unit operation of oil fields for primary production are applicable to secondary production.

The question very properly might be asked why secondary water-flooding operations have been so signally successful in the oil fields of New York and northwestern Pennsylvania without widespread unitization of the fields? The answer to this question is not difficult to give. The reason why unit operations have not been employed extensively in these fields is because of the general low permeability of the producing formations which prevents very effectively rapid movement of fluids through the reservoirs even under high pressure differentials. In this important respect these reservoirs differ from many of the much more prolific reservoirs of the Illinois basin, where, very conceivably, a minor number of wells could drain effectively an entire field of moderate size. Nevertheless, it is notable that there are many successful cooperative projects in the Allegany and Bradford fields, where common sources of water supply have been developed and operators shared the cost of drilling and operating injection wells located along or adjacent to property lines. Elsewhere in the Penn Grade Crude area, there are examples of highly successful unitized secondary recovery operations, among which may be cited the Hamilton Corners field, in Venango County, Pennsylvania, where air and gas drive was commenced by one operator in 1916, and the large Sisterville project, in Tyler County, West Virginia, which has been operated as a unit since 1933.

The right of a state to regulate the production of oil and gas is based on well defined and adjudicated principles that acknowledge the common ownership of reservoir energy in a field and a necessity for the prevention of waste in the public interest. Having shown in extensive detail how operators and landowners can share great benefits from the application of improved recovery methods, attention can now be given to the benefits that will accrue to the state and to its people by the proper exercise of this right to control the production of oil by the enactment and enforcement of adequate conservation laws. The state of Illinois can provide an excellent example.

The value of the estimated minimum secondary reserve of 350,000,000 bbl of oil to the government of Illinois and to the people of Illinois under existing price and tax schedules

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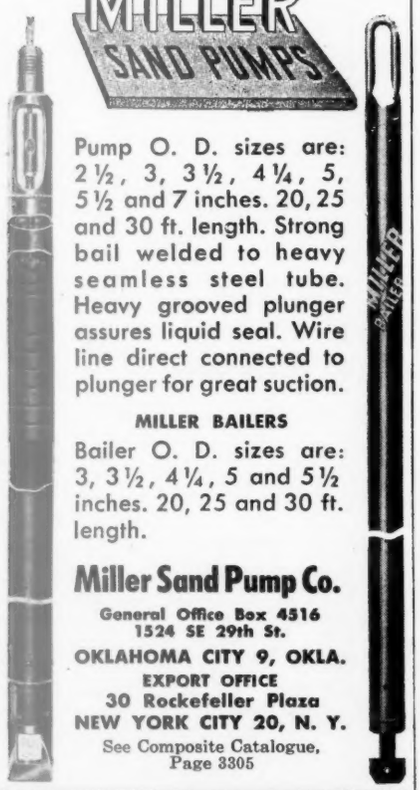

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can be determined approximately as follows:

Revenue from Severance Tax at 3 per cent and at $2.77/bbl 350,000,000×2.77×0.03, equals	$ 29,085,000
Revenue from Gasoline Tax assuming that entire secondary reserve if refined in Illinois, that half of the crude is made into gasoline, and all of the gasoline is consumed intrastate. Tax at 0.03/gal 350,000,000×.5×0.03 equals	220,500,000
Estimated production payroll at 0.309/ bbl equals	108,150,000
Estimated pipe line payroll at 0.0675/bbl equals	23,625,000
Estimated refinery payroll at 0.30/bbl equals	105,000,000
Estimated marketing payroll at 0.608/bbl equals	212,800,000
Total	$699,160,000

The following are basic assumptions used for the preceding tabulation:

For refining: 8140 employees with an average wage of $3700 per year and with average runs of 100,000,000 bbl per year.

For marketing: 13,305 service stations with an average of 2 employees each receiving an average wage of $2000 per year, and with average sales of 45,000,000 bbl of motor fuel per year.

Impressive as these figures are, it will be readily understood that they do not begin to represent the entire returns that will come to the government and people of Illinois from the anticipated production, transportation, processing, and marketing of the state's secondary oil reserve. If it were possible to estimate ad valorem taxes, the vast sums of money that will be spent in the drilling and equipping of new wells for injection and production purposes, and the cost of constructing expensive water or gas injection systems, it could probably be stated with reasonable certainty that the state government and the people of Illinois can expect to benefit from the production of its secondary reserve in the amount of about 1 billion dollars. This amout is approximately equivalent to the gross income which the oil producers and royalty owners can expect to receive from the sale of the secondary oil from which must be deducted, of course, taxes, and development and operating expenses.

With such a large source of tax and payroll revenue in prospect, it would seem obviously to the advantage of Illinois to encourage in every possible way the extensive application of methods for increasing the recovery from all of its oil fields. Some of the secondary reserve, unquestionably, can and will be produced under existing conditions and laws. However, the enactment of a conservative statute, which will enable the unit operation of fields, will go a long way to insure the maximum application of secondary methods with substantial and far-reaching benefits to land-owners, to operators, and to the government of Illinois and its people.

This consideration of the possibilities for more widespread application of secondary methods in certain of the eastern states should not be concluded without giving some attention to the profound effect the same may have on the ability of the United States to defend itself in the event our country should be separated from foreign sources of oil supply. Members of the distinguished Railroad Commission of Texas have stated that Texas' tremendous contribution of liquid fuels to the recent victory of the United States and its Allies came from fields that had been discovered and developed prior to the commencement of hostilities, and in which large reserve productive capacity existed by reason of wise administration of the State's conservation laws. New discoveries during the War years, although of great importance as an assurance of future oil supply, nevertheless made only a minor contribution to war-time demands for oil products. Similarly, the writer believes confidently that it will be much easier to supply possible present or future emergency requirements for liquid fuels from oil that has already been found rather than from oil which remains to be discovered. We certainly can consider it to be a patriotic obligation to dedicate a great deal of thought and attention to the enactment of appropriate laws and to essential technical studies for the purpose of making large secondary reserves of oil available at the time they may be needed most. Likewise, the writer believes firmly that a great part of the known oil reserve of the United States can be produced more profitably and more expeditiously, and with greater overall benefit to the people of this nation than the immediately forseeable production of substitute synthetic liquid fuels.

References

1. Don T. Andrus, "Secondary Recovery Research—An adventure in Conservation," Interstate Oil Compact Quarterly Bulletin, Volume V, Number 2, August, 1946, pp. 16-26.
2. J. P. Jones, "Conservation and Secondary Recovery," presented as testimony before the House of Representatives Armed Services Subcommittee, February 6, 1948, and reprinted in the February, 1948, issue of *Producer's Monthly*, Volume 12, No. 4, pp. 18-23.
3. Paul D. Torrey, "A Preliminary Statement on Secondary Recovery Prospects and Possibilities in Various Parts of the United States," Interstate Oil Compact Quarterly Bulletin, Volume VII, Number 2, September, 1948, pp. 60-65.
4. Frederick Squires, Paul G. Luckhardt, and Alfred H. Bell, "Secondary Recovery in Illinois," Chapter 42, Second Edition of API "Secondary Recovery of Oil in the United States," 1950, pp. 505-521.
5. R. R. Vincent and K. P. Huffman, "Resume of Water Flood Operations in Illinois, Indiana, Kentucky, Ohio, Michigan, and West Virginia," paper presented at API Eastern District, Division of Production, Cleveland, Ohio, April 28, 1950, Paper 826-21-F. ★ ★

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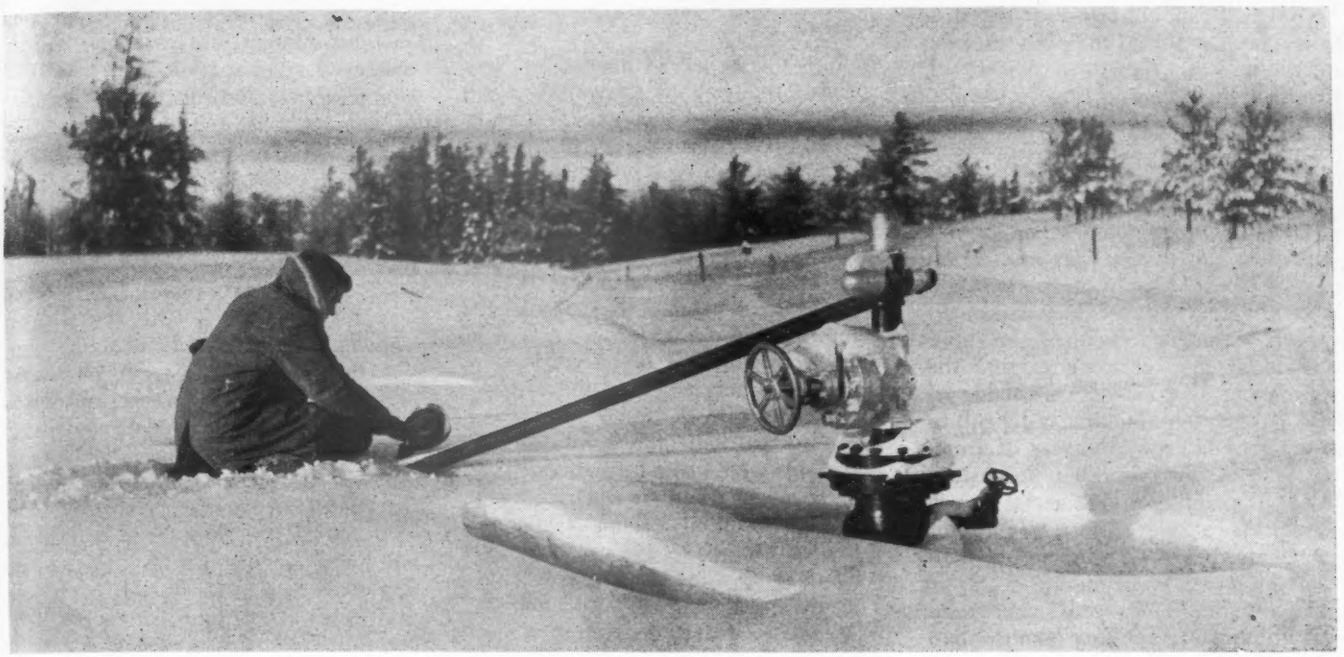

Operator checks valves on a christmas tree at Imperial Simmons No. 1 near Edmonton, Alberta.

Canada's Progress in 1950

L. O. Rowland*

An astonishing rate of activity in all divisions was the outstanding feature of Canada's petroleum and natural gas industry in 1950. This activity led to significant progress in technical discoveries and applications, while at the same time there were economic and legislative factors that affected operations. Among the notable events of the past year were: The first full summer operation in muskeg country for geophysical crews; the introduction of airborne geophysical operations on a large scale; a speed-up in the completion time for development wells, facilitating the completion of more than twice as many wells as had ever been drilled before in one year with an increase of only 60 per cent in the number of rigs working; the extension of known productive area in the Leduc-Woodbend oil field and a great addition to factual information on shape of the productive area and on reservoir conditions; the first full year of operation of an important water-flooding secondary recovery project in the old Turner Valley field; the construction of Canada's first major crude oil pipe line with probably a world record for speed in relation to distance; an enormous program of expansion of refining capacity on the prairies and in eastern Canada; the introduction of catalytic cracking units on an unprecedented scale, and great progress in research on methods for economic extraction of crude oil from the "tar sands" of the Athabaska region in northern Alberta.

Exploration was rather anomalous, in that a tremendous increase in activity and range of operations, combined with the use of many technically improved instruments and equipment items, as well as a vastly larger quantity of crew days, did not result in a discovery rate as high as that of 1949. The most important features of exploration were the improved techniques and the lowered costs resulting from them.

From fewer than 100 crews operating on the prairies at the end of 1949, the total number increased to a high of nearly 140 at the height of activity in the summer, and was still over 120 at the end of the year. Two of the largest airborne magnetometer surveys ever flown were completed during the summer,[1] in areas where the cost and technical problems of completing a ground-based survey would have been prohibitive. One aerial survey covered about 25,000 sq miles in the Peace River area of northwestern Alberta. The entire area was flown in 13 weeks by an Avro Anson aircraft with a ground monitoring station and a total crew of 9. The aircraft was hired on contract.

On this survey a Gulf magnetometer was used, with a duplicate instrument in the ground monitoring station to detect the magnetic disturbances characteristic of the area. The operators reported that the survey afforded a sound test of the airborne magnetometer's utility and performance in a

*Editor, *Oil in Canada*.

[1]By Aeromagnetic Surveys, Ltd., Toronto, and Canadian Aero Service, Ltd., Ottawa.

EXCLUSIVE

very significant area (since exploration play at that time was moving north) and that the order of accuracy was 1 or 2 gammas.

Although it is too early at present to analyze the results of the survey, as the last magnetic intensity maps were just being delivered at the year end (first delivery September 25), it was felt when the survey was authorized that significant geophysical data would be delivered concerning basement depths, basement structures and other aspects of the rocks underlying the sediments. Absence of knowledge of regional geology, making it difficult to direct ground crews to areas of greatest interest, was another important factor in deciding on the aerial survey which, for reasons of cost, was a joint enterprise of 4 oil companies with large reservations in the area.

Tie lines and loops were so arranged that no magnetic reading is more than 3 miles from a control point. The total cost was $150,000, including delivery of map sheets compiled at a scale of one mile to the inch with a contour interval of 5 or 10 gammas as dictated by local gradients.

The helicopter came into its own in 1950 as an efficient mechanism to conduct airborne exploration, particularly on gravity meter work. Detailing this type of operation in a symposium at the joint AAPG-SEG regional meeting

Photos courtesy IMPERIAL OIL, LTD.

in Banff, Alberta, in September, one speaker reported that accuracy ratio of 82 per cent has been experienced in his company's[2] operations. An aneroid type barometer has been developed, used in conjunction with a field altimeter synchronized with the base altimeter. The margin of error is less than 2½ ft on vertical elevations.

This was the first full year of continuous helicopter operation. A typical survey covering 450,000 acres in very inaccessible territory 265 miles north of Edmonton in the muskeg area was done by two helicopters. Specific assignments were given to each machine, with excellent results in efficient operation and economy. Time taken for horizontal fixes was not more than 30 seconds to 1 minute on the average. The entire job occupied only 5 months, averaged 36 gravitymeter stations per township, and cost a total of 22 cents per acre.

On seismic work, the same company reports that with the experience it has gained in the past year and a half of helicopter use it can move an entire location in 3 round trips, including transportation of personnel.

Ground survey crews on muskeg work proved that year-round seismic work is completely practical by operating for the entire summer of 1950, an accomplishment new in exploration history. Use of the versatile "weasel" contributed materially to the success of summer muskeg shooting.

The weasel is a light crawler-tracked tractor powered by a conventional automobile engine. Its distribution of weight over a large area allows it to traverse soft areas that would bog down conventional vehicles. Crew size was cut down to 8 with the use of weasels and the supply problem was lightened.

Normal set-up of a weasel train, according to another speaker[3] at the SEG symposium, is a 4-unit fleet, every unit self powered: Drill, water tender, recorder, and shooter. Weasels operated mostly on lines that had been bulldozed during the frozen winter period, as the weasel can not push over trees itself and conversely the bulldozers can not operate on soft or swampy ground in the summer. Lines cut in the winter were found to be cheaper than summer-cut lines.

Contributing materially to the success of this historic summer of muskeg and bush operation was the introduction of super-light equipment. Practically every item has been developed in portable form. The Mayhew 100 shot-hole drilling rig and its contemporary the Carey's portable muskeg rig are used by operators in this area. Recording equipment has been made completely mobile and portable, including such items as cable reels that carry a quarter mile of cable, light weight small geophones and amplifiers, cameras, and developing boxes. Field operations under the most severe conditions proved last summer that the portable outfits are just as accurate as conventional truck-borne equipment.[4]

Experimenting with compressed air for shot-hole drilling instead of the conventional mud was carried on by some companies for the first time but results were too inconclusive to permit any forecast of general application.

One of the most unorthodox results of the past year's geophysical camp operations has been the shattering of an old rule that there was a "lower limit" of cold weather for efficient work. One operator[5] gave an illustration of a typical incident from last winter in his report at the SEG meeting. On 2 days in January the crew laid off because the temperature had dropped to 55 deg below zero. (This is not exceptional cold in some of the more northerly regions). After the 2 days layoff the crew was so restless that the party chief allowed them to go out at minus 62 deg the next day. They

[2]United Geophysical Company, Inc.

Member of seismograph survey party drills a shot hole.

[3]Geophysical Service, Inc.
[4]Southwestern Industrial Electronic Co.
[5]Northwest Seismic Surveys, Ltd.

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drilled and shot 4 holes 5 holes from the camp, with no visible adverse effect on the men and with no impairment of accuracy in the results. Vehicles suffered more than men, and so far no effective cure for cold weather breakdowns and hard starting has been found. The Defense Research Board began work during 1950 on an extensive research program on special lubricants for winter operation, but is not yet in position to report, so that presumably this current winter will present the same problems.

A great deal of subsurface information was developed in 1950 through wildcatting and field development, although the discovery rate was down from 1949. Natural gas horizons were found with commercial flows in the great bulk of wells drilled in search of oil, and the presence of commercial quantities of gas was established in 28 different areas. Natural gas has been found during the year in the Viking sand, in the Lower and Basal Cretaceous sands, in the Madison and Devonian limestone. Total gas reserves in Viking sand are estimated at two trillion cubic feet or about 30 per cent of all Alberta reserves.

A feature of the year's wildcatting was the discovery of Lower Cretaceous sand crude oil in commercial quantities at 3 locations: North Woodbend, Acheson-Stony Plain, and Ellerslie. All are within a very few miles of the city of Edmonton. At the present time government regulations are not considered conducive to the highest level of wildcatting activity in search of Lower Cretaceous production. The lenticular nature of the sand formations, and the fact that well spacing is limited to the province-wide 40-acre locations, make most operators leery of drilling specifically for this zone unless there is prospect of other producing horizons. The reason is that there is a tendency for the lenses to pinch out, so that offset wells to discoveries have almost an even chance of being dry. Suggestions have been made that a 10-acre spacing would promote more active development of discovery areas and more definite programs of wildcatting for Lower Cretaceous.

With the three previously discovered Lower Cretaceous pools at Leduc, Whitemud and Campbell, also in the Edmonton area, 1950 has brought this interesting but rather unreliable zone into a prominent position. More than 25 producing wells were drawing from the formation at the end of 1950.

The Devonian proved to be undisputed leader in the discoveries of 1950, as well as in the development of proved fields. Dual zone discoveries in Devonian at Big Valley (Stettler area), Flint-Camrose (central Alberta), and Acheson-Stony Plain (Edmonton area)[6] all occurred in the last 4 months of the year, after 10 months of profitless wildcatting. It is too early to attempt to draw any conclusions about probable reserves.

The most interesting Devonian development of the entire year was made in December at a stepout well drilled 2 miles from the Flint discovery in the Camrose area, central Alberta. This well, Socony Duhamel No. 29-14, of Socony Vacuum Exploration Company, penetrated 121 ft of porosity in D2 zone of Devonian, finding a gas cap in the upper 66 ft (more than twice the thickness of the Leduc gas cap) and crude oil of 34 API gravity in the 55 ft below, with overlapping gas flows for 15 ft.

The Duhamel well has the thickest D2 section in Alberta, with top at 4417 ft, and potential crude oil flow was estimated at 2000 bbl daily on basis of four drillstem tests in the oil zone. Gas flow calculated on cumulative basis from three drillstem tests was estimated at 14,000,000 cu ft daily.

Of considerably more than 900 wells completed in the year, develop-

[6]Gulf Big Valley No. 1; Socony-Vacuum Flint No. 1; Imperial—California Standard Acheson No. 1.

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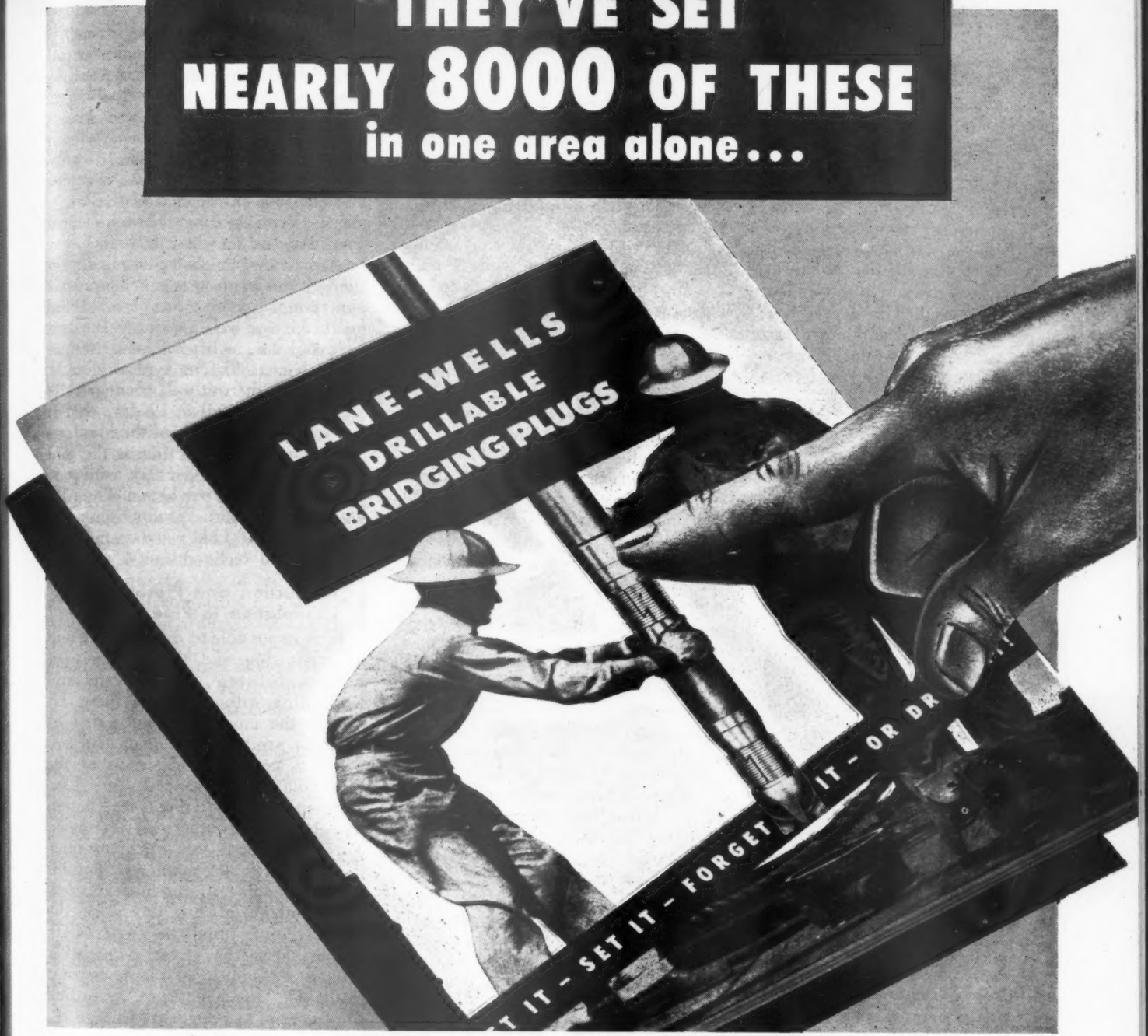

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ment drilling in the major Devonian fields of Leduc-Woodbend and Redwater accounted for about 600 between them. Approximately 450 wells were completed as successful producers in the Redwater field alone.

The heavy completion rate has been dictated by offset requirements, owing to the extremely vuggy and fractured type of producing formation in the Redwater field. The past year's drilling operations have been uneventful, because appreciation of the technical problems has resulted in a very cautious casing program and other precautions to avoid blowout hazards. Casing program has been stabilized with between 400 and 600 ft of 10¾-in. surface casing set with 200 sacks, production string of 7 in. set to the top of the D3 zone, and drilling normally halted a few feet into the zone for open hole completion with acid treatment. One field production superintendent described the Redwater development as "very dull and therefore very satisfactory."

An interesting and very promising structural surprise resulted in November from the drilling of a well[7] at the extreme southeast corner of the producing area and almost half way in the east-west plane between 2 dry holes. This well found D3 top at elevation 25 ft higher than the producer it offsets to the northwest, indicating a pronounced rise in thickness of the reef at a point where it had been assumed it was thinning out. The shape of this 18-mile-long reef is becoming established as an extenuated crescent, with distinct possibility of another mile or two of thick pay zone at the south end. In common with most of the reef fields of central Alberta it has now been established conclusively that the Redwater reef has a gradual slope on the southwest flank, with the northeast flank dropping off abruptly, in some places almost at a 90-deg angle.

Development of the Leduc field during the past year has been shifted in emphasis to "fringe" drilling of the D2 (upper) zone, mostly on basis of farmouts from major companies holding the oil rights. Farmout terms usually provide for the grantee drilling the property in return for a comparatively small royalty of a fixed number of barrels payable out of a percentage of production. Success was about half and half during the past year, and the new producing wells served to define the limits of the D2 zone a little more definitely, indicating that there are a number of extenuated fingers of this zone running south, southwest, and southeast from the main producing area. In the course of this drilling, two anomalous D3 producers[8] were completed in the middle of groups of D2 wells, and tentative interpretation is that the D3 zone is intermittent in that area although elsewhere in the field it is more uniform and continuous than the D2. It is evident from the 1950 development of the fringes that a good number of Leduc field locations not yet drilled may be productive.

The first secondary recovery project in Canadian oil fields was introduced into the Turner Valley field by Royalite Oil Company Limited in the fall of 1948 and in 1950 was turned into a joint water flooding and gas lift method, which, although inconclusive as yet, has given promise of increasing flow rate of the one well on which it has been operating.

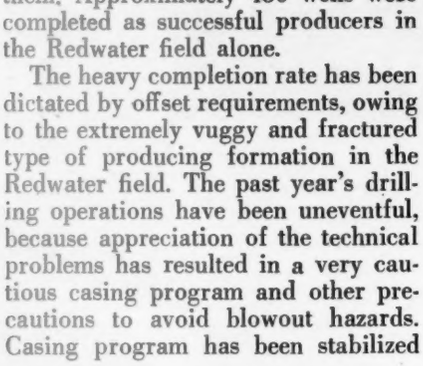
Indicated primary recovery from the Turner Valley field, due to early wasteful production methods, is calculated at only 15 per cent of the oil in place. Permeability is both low and irregular, and no water drive has ever existed, so that the water flooding portion of the project is considered as pioneering. Injection has been carried on through a well adjoining the test well, and the gas lift has been used as a supplement. In one typical month, April 1950, the test well produced the same amount of oil in 19 days that it had in the full 30 days of the previous April. Current production at the end of May was 144 bbl per day, with gas-oil ratio 875 cu ft per barrel. The previous September, production had fallen below 100 bbl per day and gas-oil ratio had declined to 604.

Production and Proration in Relation to Pipe Line

It is impossible to discuss the trend of production and the emphasis of drilling between development and wildcatting, without relating these factors to the most important event of 1950 for producers: The construction within a period of 150 days of the 1150-mile Interprovincial Pipe Line Company's crude oil line from Edmonton, Alberta, to Superior, Wisconsin. This line, when it goes into continuous operation for the summer months, will be capable of moving approximately 50,000 bbl per day down the Great Lakes to supply the Imperial Oil refinery at Sarnia, Ontario, and other refiners as additional plants become available. This will mean, according to Imperial's president George L. Stewart, that Alberta producers will be able to dispose of a daily average of 131,000 bbl in the summer season. Assuming a continued rate of development at the current speed of more than 2 wells a day, the number of new wells coming on production will overtake the pipeline transportation capacity by the end of the summer, which will involve cutbacks in the fall when movement is slowed down by reason of lake navigation closing.

A change in emphasis from development of proved areas to more intensive wildcatting to discover new fields was recommended by the Imperial president in a public address in October—probably the outstanding declaration of policy since the Leduc discovery and a reiteration of Imperial's recommendation to the provincial Conservation Board at the time the Redwater field was discovered.

[7]Texaco-McColl No. F2.
[8]Imperial Leduc No. 280 and P. D. Leduc No. 1.



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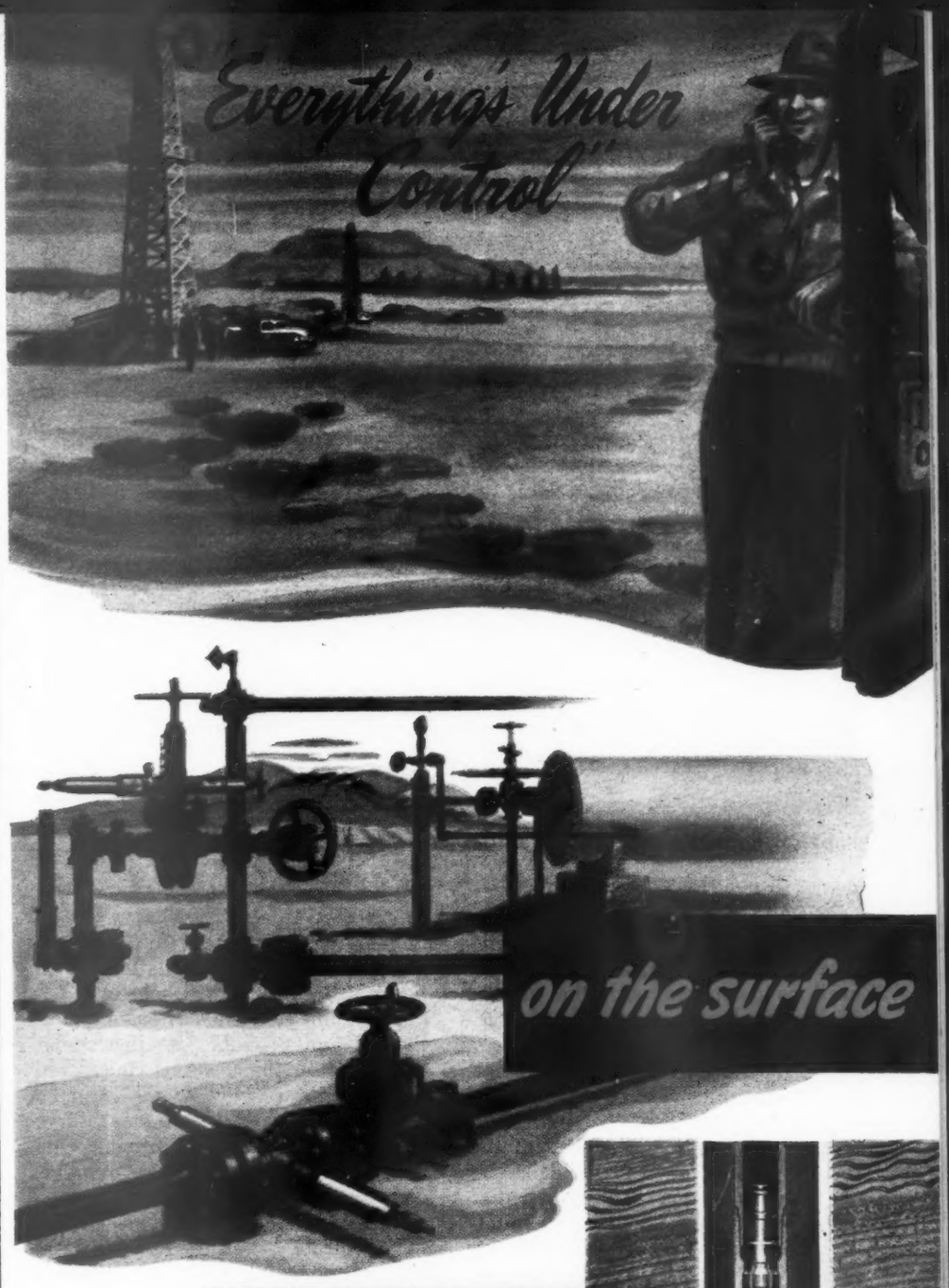
If Stewart's recommendation is adopted generally by the industry, it will probably force some small producers to slow down their rate of expansion, as many will not be able to afford the high cost of wildcatting with the increasing cost of exploration for new fields. In the long run, however, this would help the production branch by avoiding excessive development of proved fields, which most engineers admit has been the case with Leduc and Redwater where wells have been drilled "prematurely, if not unnecessarily" according to Stewart. The 1950 operations, however, were highly satisfactory to the drillers, most of which are independent contractors, and the proportion of available rigs working reached about the highest mark in their history towards the end of the year with nearly 140 rigs either drilling or moving to locations. Technical progress has cut drilling time on development wells, with a new record set during the summer, of 44¾ hours from spudding to total depth on one Redwater well completed at the average field depth of around 3300 ft.[9] The practice of skidding rigs to offset locations, instead of tearing down and rigging up again, was a feature of 1950 operations and effected economy as well as greater speed.

The construction of the Interprovincial pipe line was a technical achievement of a high order and has earned for it the nickname of "The Fastest Inch." Contractors were: Bechtel Corp.-Fred Mannix; Williams Brothers Corporation and Anderson Brothers. Its presence emphasizes, however, the dependence of the entire industry on further transportation channels in the immediate future. The proposition that an increased discovery rate take precedence over drilling out proved fields may set an interesting objective beyond 1950. If a number of fields can be delineated, the planning of further pipe lines may be able to take into account the most economic gathering systems and the actual routes of such trunk lines.

The reduction in wellhead price that producers will have to take next spring, when Alberta crude moves into the marketing area presently served by Mid-Continent crude at the eastern Great Lakes, was indicated at completion of the pipe line to be smaller than had been expected. The tariff announced at mid-October will amount to 54 cents (Canadian) per barrel Edmonton to Superior, with total charges, including lake tanker movement to Sarnia, averaging about 80 cents per barrel. The present price of crude at Sarnia being approxi-

[9]Drilling contractor: General Petroleum of Canada, Ltd.



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Imperial Redwater No. 1 well derrick on Hilton Cook farm.

mately $3.30 per barrel, this would give the producer $2.50 at the wellhead as compared with the present $2.73 at Redwater and $3.05 at Leduc-Woodbend.

In 1950 for the first time, Canadian income tax returns were permitted to be filed on 1949 income claiming full deduction as current expenses of the cost of drilling all wells, whether or not the wells were productive. Whether or not producing well costs are capitalized and written off immediately or carried over a period of years for internal accounting purposes, a company may now write them off against current income in the year in which they are incurred. This provision undoubtedly contributed to some extent to the doubled rate of drilling in 1950 over 1949.

Natural Gas

The discovery rate for natural gas was stepped up greatly in 1950, and, in conjunction with the latest report on gas reserves by Dr. Hume and Ignatieff of the dominion department of mines and technical surveys, published in September, lent increasing weight as the year went by to arguments in favor of a definite policy of permitting export from the province. The notable feature of the year was the formal submission of engineering data by all applicants for permission to build export gas pipe lines. In addition, a joint hearing on the subject of deliverability and reserves, held during November and December, resulted in the filing of technical information which had not been published before.

Dr. Hume's estimate of gas in place, proven and probable, at just under 7000 million cubic feet, is considered authoritative in view of his intimate experience with Alberta gas reserve calculations and his continent-wide reputation as a gas authority. When it comes down to recoverable reserves, submissions made at the recent hearings indicate a figure of about 5500 million cubic feet. These are sufficient to establish the province of Alberta as a major gas producing area.

As the year closed, there were 5 separate and distinct applications before the Alberta Conservation Board for permission to export natural gas by pipe line. These are as follows:

(1) Pacific Northwest Natural Gas Company, proposing to build from Houston area to the Pacific Northwest, with branch line from Pincher Creek area of Alberta to its main line.

(2) Westcoast Transmission Company, proposing to build a line from the Pouce Coupe area of northeast British Columbia at the boundary with northern Alberta, through Pine Pass to Prince George, B. C. and thence to Vancouver, B. C., with branches to Spokane and Portland from points near the border.

(3) Western Pipe Lines, proposing a line eastward from the southern gas fields of Alberta to serve the cities and towns of the Canadian prairie provinces as far east as Winnipeg, then continuing to cities in the northern states of Minnesota and North Dakota.

(4) Canadian Delhi Oil Company, proposing a line from central Alberta to Montreal, following the main line of the Canadian Pacific Railway and going entirely through Canadian territory.

(5) McColl-Frontenac Oil Company Ltd. and Union Oil Company of California, proposing a short line of small capacity from the Pakowki Lake region of southeastern Alberta to the existing lines of Montana Utilities Ltd. and destined largely for the Anaconda copper smelter at Butte.

(6) Alberta Natural Gas Company, subsidiary of the Delaware corporation, Northwest Natural Gas Company, applying for a route to the western states by way of the Crowsnest Pass and Bonners Ferry, Idaho.

The fundamental issue raised by the Alberta Conservation Board, which has been holding hearings intermittently during the past year on the subjects of reserves, deliverability and markets, is whether the indicated reserves are adequate to protect the requirements of the domestic public utilities in Alberta for a 30-year period and also to take care of the requirements of at least one export pipe line.

Originally the Alberta Government had set a 50-year reserve requirement. This has now, by implication although not by explict statement of policy, been reduced to 30 years as the latter is the normal period of amortization of natural gas pipe lines and is as long a period for which any petroleum engineer or reserve statistician has been willing to commit himself to an estimate of requirements.

As the year closed there appeared no immediate prospect of a decision on the question of whether the reserves so far proved and probable can support any export of natural gas. There was, however, an indication of a major change in government policy on exploration and drilling for natural gas. On recommendation of the Western Canada Petroleum Association, the Alberta Government has started to draft new regulations relating to gas developement, which are understood to give much more liberal terms to operators who will undertake an exploration and drilling program specifically in search of natural gas. These new regulations are expected to be announced early in 1951.

The objective is to induce operators to prove up enough additional reserves to allow the Alberta Government to conclude that permission to export may be granted safely. The public utility companies have filed submissions stating requirements of

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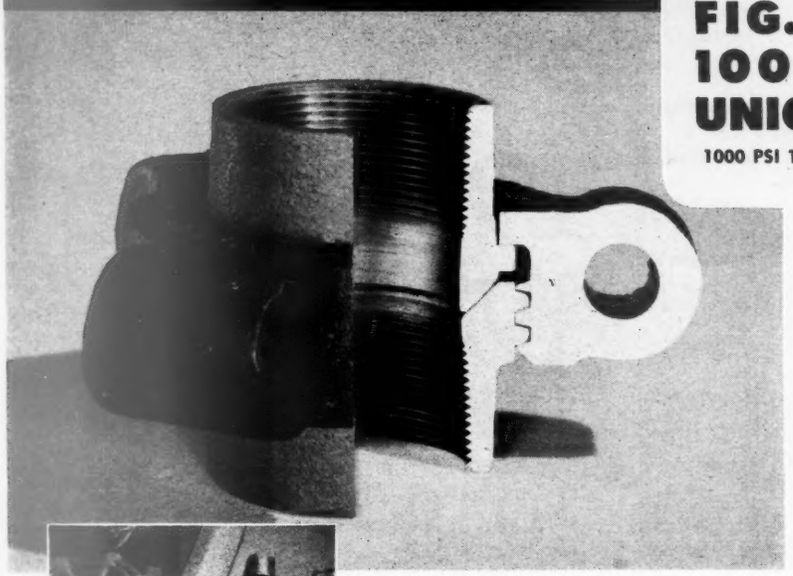

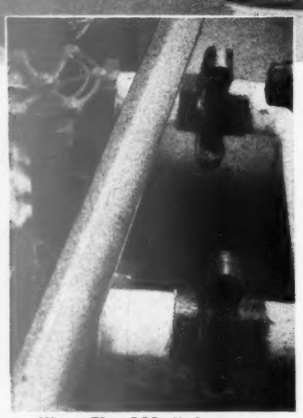

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approximately 1250 million cubic feet to meet their consumers' demand to 1980. The question is still open whether the proving of this amount in addition to existing reserves would result in an export permit or permits being granted, as the Alberta Government has not stated any definite figure as representing the required 30 years' supply. The question is still open, too, of how many out of the five applicants, and which of them, will be able to get export permits.

No severe technical problems are represented in any of the proposed routes, except that the eastern route across the prairies would be the least costly per mile as it has the easiest terrain to cross. To balance this factor, the west and southbound routes offer probably larger markets within a shorter distance of their prospective supply sources.

A change of approach to the problem of developing economically the "tar sand" reserves of the Athabaska River region in northeastern Alberta, believed to contain upwards of 250 billion barrels of crude oil, was a feature of research being carried on by the Canadian Mines Branch. As reviewed by Dr. T. E. Warren, one of the chemists in the fuels division of the Mines Branch, the emphasis is on finding an economical method of converting the bitumen into a normal range of the major products ordinarily refined from crude oil, in the proportions in which they are required by available markets.

The primary objective of current research is to find a process for converting bitumen to ordinary petroleum equivalent which can be processed in any refinery. "Even if no further improvement takes place, there is assurance that separation of bitumen from bituminous sand is technically feasible and not excessively expensive," says Dr. Warren. One method of separation has been operated on a scale of 500 tons of bituminous sand per day and fulfills the requirements for maximum economy in operation "to an adequate degree."

Dr. Warren indicates that with the separation process in the most advanced stage of development, the major research effort should now be directed towards improvement of the application of coking and hydrogenation to bitumen in order to develop the best process for conversion to the type of crude which can be used for refinery charging stock.

The possible strategic value of these reserves is probably justification for the attention being paid to them, and a prolonged defense program could conceivably speed the development of the processes outlined. ★ ★ ★

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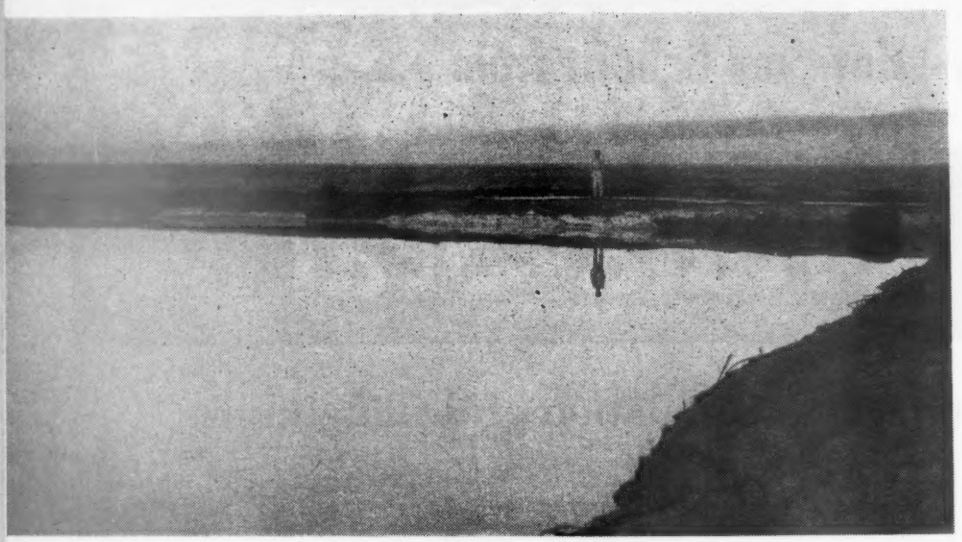


Part of one of the large evaporating pits in Henderson field.

HENDRICKS AND HENDERSON

Some Operating Problems in Old Limestone Reef Fields

K. Marshall Fagin*

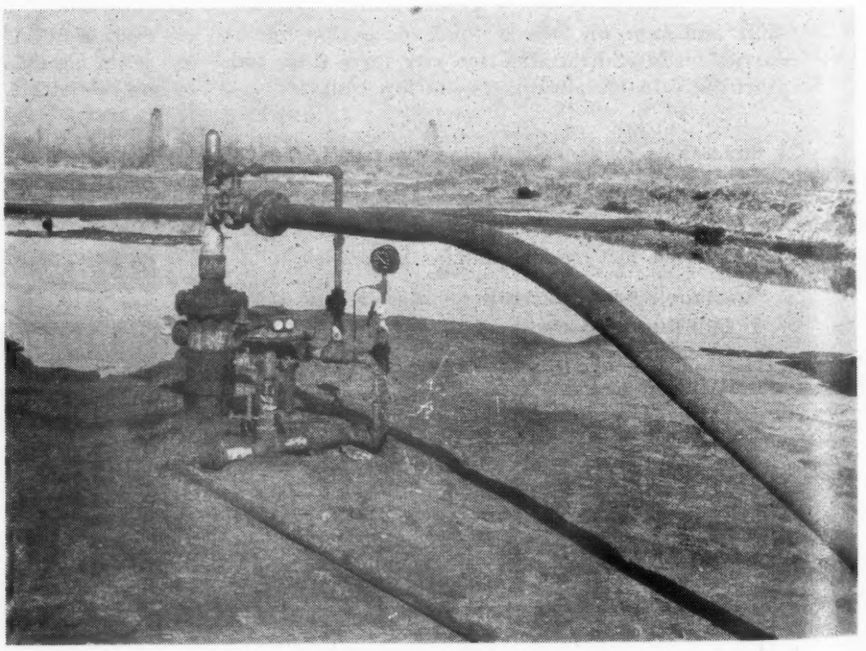
ALTHOUGH operating problems in the old Hendrick and Henderson fields of Winkler County, Texas, are typical of some other limestone reef fields that have been flooded by an effective natural water drive, many of the problems are peculiar to the individual fields and to the individual wells. Some of the differences in the problems arise from differences in the methods of casing, equipping, and completing the wells. Other differences arise from the various methods of producing the wells and from the variations in the effectiveness of the natural water drive. A study of operating problems in old fields such as these and the differences from well to well and from reservoir to reservoir should be worthwhile not only to the operators in these fields, but also to operators confronted with similar problems in other fields—newer or older.

The main problem common to both of these fields is to produce enough fluid to obtain enough oil to pay for the continued operation of the wells. It is true that a few of the wells are still quite profitable to the operators; however, the operations as a whole are not very profitable, and most of the wells are recognized as "strippers".

Discovery Data

R. A. Westbrook and Company's T. G. Hendrick well No. 1 in section 42, block B-5, was completed for 120 bbl of oil per day from total depth of 3006 ft on July 9, 1926, as the discovery well in the Hendrick field. It was take over by Southern Crude Oil Purchasing Corporation and drilled deeper to 3052 ft, where it was recompleted for 390 bbl of oil per day on November 8, 1926. Later wells in the Hendrick field were completed for potential flows of as much as 4000 bbl of oil per hour. The potential (1 hr flow × 24 hr) of the 468 wells drilled on 8360 acres in the field at the beginning of 1929 was 2,655,787 bbl per day, an average potential of 5675 bbl per day per well.

Wahlenmaier's Leck No. 1 in section 3, block 26, was completed as the "non-commercial" discovery well in



A well in the Hendricks field that is produced through the tubing by gas injected into the casing-tubing annulus. A pressure-operated snap-action surface-control valve injects gas at 300 psi intermittently to keep the well flowing.

*Editor, *Drilling and Producing.*

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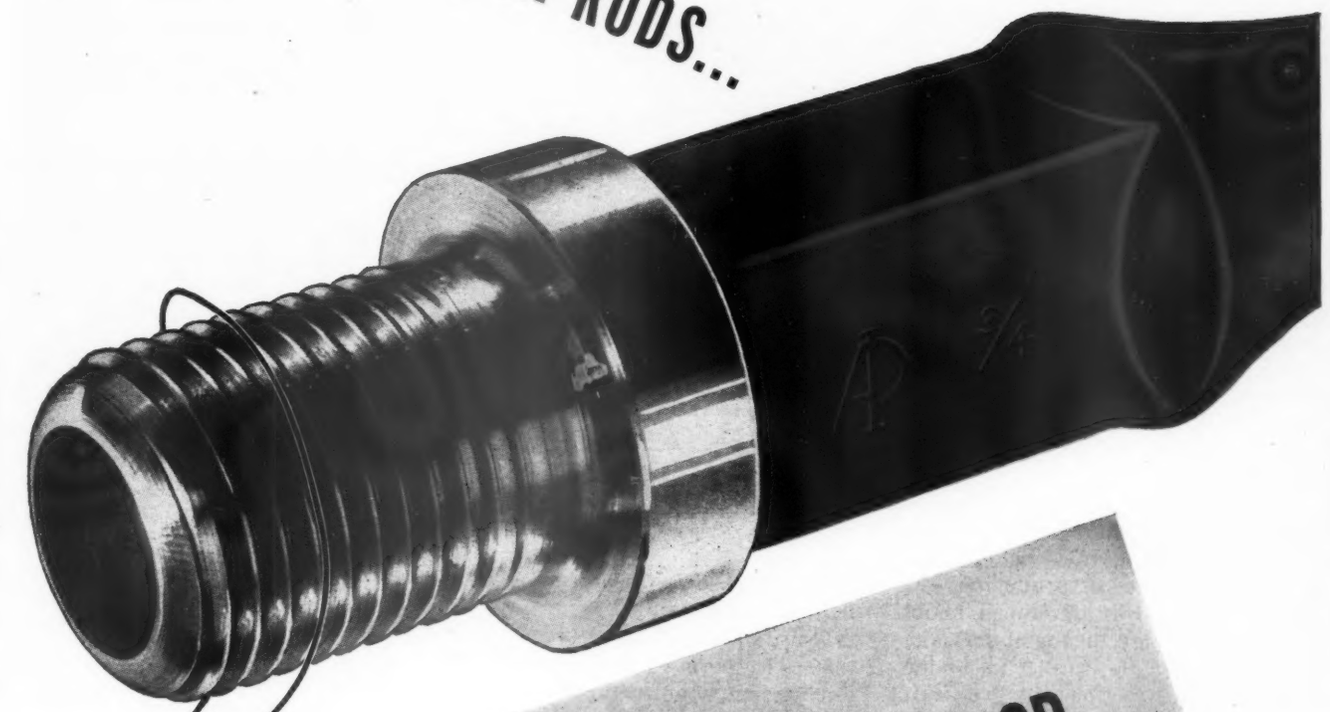

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the Henderson field with a potential of 25 bbl per day in November, 1933. Development of the Henderson field, which is just north of Hendrick, did not begin until 1936, and the wells were not as prolific as those in the Hendrick field.

Geology and Structure

The Hendrick field is an anticlinal reef structure about 9 miles long, from north to south, and 3 miles wide, containing about 12,000 proved acres. Most of the oil production has been obtained from the white lime section of the "Big Lime" of the Seven Rivers section of the Permian. The average depth to the top of the Seven Rivers is about 2740 ft. The average surface elevation in the field is about 2810 ft, and the average pay zone thickness is about 300 ft.

Production has also been obtained from the brown lime section of the Big Lime in some areas in the field. The first prolific oil producing section, however, was developed about 150 to 250 ft below the top of the white lime, except on the west flank of the structure. This section was gas bearing on the top of the fold, and oil was seldom produced until the wells were drilled about 300 ft below the top of the white lime.

The depth of the first oil pay is more variable on the east side of the field, and was found as much as 400 to 450 ft below the top of the white lime. The porous zones in the white lime are fairly uniform from the west edge to the crest of the fold, but are not correlative with the porous zones on the east flank.

The reef limestone producing section is as much as 700 ft thick in a few wells, and some of the cores suggested evidences of fissuring in the dolomitic limestone producing sections.

The Henderson field is a similar North-South anticlinal reef structure and contains about 2800 proved acres. The dolomitic limestone beds dip slightly to the west and grade into dense anhydrite and shales to the east. The top of the Seven Rivers is about 3050 ft deep, and the surface elevation is about 2875 ft. The producing formation is not as porous, permeable, or as thick as the one in Hendrick. The average thickness of the producing zone is about 100 ft.

TABLE 1. Production and data on producing wells.

Year	Hendrick field: Crude oil production during year, bbl	Hendrick field: Number of wells producing at end of year: Total	Hendrick field: Number of wells producing at end of year: Flowing	Hendrick field: Number of wells producing at end of year: Art. lift	Hendrick field: Avg. daily prod. per well, bbl	Henderson field: Crude oil production during year, bbl	Henderson field: Number of wells producing at end of year: Total	Henderson field: Number of wells producing at end of year: Flowing	Henderson field: Number of wells producing at end of year: Art. lift	Henderson field: Avg. daily prod. per well, bbl
1926	5,096	1	y	y						
1927	3,109,523	37	y	y	231					
1928	58,916,626	468	y	y	344					
1929	50,144,411	560	y	y	246					
1930	26,285,121	612	y	y	117					
1931	15,338,397	534	y	y	79					
1932	10,229,339	414	184	230	68					
1933	7,355,964	416	239	177	48					
1934	6,356,359	449	237	212	39					
1935	5,700,186	426	y	y	37					
1936	4,791,768	392	183	209	34	217,466	43	42	1	14
1937	4,630,700	376	109	267	34	1,355,183	113	113	0	33
1938	4,046,916	367	89	278	30	1,022,825	126	123	3	22
1939	3,326,736	326	90	236	28	877,496	137	134	3	17
1940	2,952,753	307	81	226	26	980,413	139	137	2	19
1941	2,814,056	304	85	219	25	876,548	139	131	8	17
1942	2,512,213	310	56	254	22	1,126,109	138	119	19	22
1943	2,072,989	308	36	272	18	1,672,435	139	106	33	33
1944	1,736,814	253	37	216	19	1,851,809	138	87	51	37
1945	1,531,535	239	32	207	18	1,203,060	102	56	46	32
1946	1,375,713	219	33	186	17	668,909	78	43	35	22
1947	1,287,144	220	29	191	16	516,400	73	31	42	19
1948	1,225,605	209	26	183	16	425,750	66	26	40	17
1949	1,280,070	193	26	167	18	309,401	66	26	40	13
1950	1,250,000*	190*			18*	250,000*	66*			10*
	220,276,034†					13,353,804†				

* Estimated.
† Cumulative production.

About 16,000 bbl of fluid is produced from this well in the Hendricks field by injection of about 500,000 cu ft of gas. The well is equipped with both 2 ½-in. and 1 ¼-in. tubing. About 50 bbl of oil per day is skimmed off the water.

Reservoir Data

The initial reservoir pressure in the Hendrick field was estimated as 1720 psi at sea level, which is about 2800 ft deep. The "rock" pressure (shutin pressure at the wellhead) of some of the early wells, however, was reported to be about 1300 psi, which would indicate an even higher initial pressure than estimated. One well was reported to have had a rock pressure of 1620 psi. These high initial pressures were responsible for the high initial "potentials" of the wells.

The initial reservoir pressure in the Henderson field was estimated as 1450 psi; however, the average bottomhole pressure at the end of the first year's production (December 31, 1936) was reported to be 1321 psi, which indicates a rapid decline after the production of only 218,000 bbl of oil. The average bottomhole pressure was reported to be 1282 psi at the end of 1942, after the production of some 6,000,000 bbl of oil. Thus, a much slower rate of decline than in the first year was indicated.

Baash-Ross News

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IT PROTECTS . . . drill collars, flush pipe, tubing, etc., from dropping through the rotary table.

IT LIFTS . . . casing, liners, drill collars, pipe, tubing—even twist-offs—as temporary elevators.

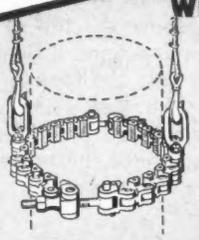
IT SNUBS . . . drill pipe and tubing against upward movement when cementing, working under pressure, etc.

IT PULLS . . . pipe sections and similar cylindrical products horizontally for aligning, positioning, welding.

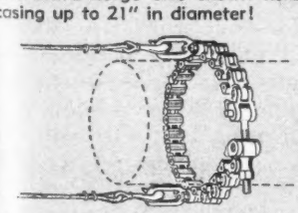
Regular Size Safety Clamp (Type CR), above, fits diameters 3¾" to 10⅝". Large Size (Type CL) fits diameters 11½" to 15½". Extra Large Size (Type CXL) fits diameters 15½" to 21". Tubing Size (Type T) fits diameters 1⅛" to 4½".

HERE THE SAFETY CLAMP (Regular size) is used to prevent drill collars and similar flush joint equipment from dropping through slips in the table. It is ideal for use with Baash-Ross Drill Collar Slips to give **double** protection against slipping!

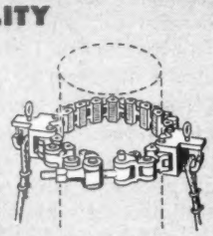
WIDE ADAPTABILITY



FOR LIFTING casing, pipe, liners or tubing, the Safety Clamp is equipped with lifting ears through which a sling can be fastened to substitute for elevators. The Extra Large Size shown here fits casing up to 21" in diameter!



FOR PULLING pipe lines or pipe sections into alignment for welding, coupling or positioning, a Safety Clamp fastened around the pipe provides a slip-proof grip for pulling manually or mechanically.



FOR SNUBBING drill pipe and tubing, the Safety Clamp is simply inverted so the slip segments pull down instead of up. Easily-attached hold-down ears permit fastening anchoring cables with maximum speed and simplicity.

Get Complete Details on the many ways Baash-Ross Safety Clamps can increase the safety and efficiency of your rig operations. Your local supply dealer will gladly supply full information —or write direct!

There seems to be no limit to the variety of jobs operators have figured out for the Baash-Ross Safety Clamp. Originally designed to take a quick, slip-proof grip on drill collars, liners and other flush joint equipment to prevent it from dropping through the table, it is now available in four sizes—Tubing, Regular, Large and Extra Large—to lift equipment *up* . . . or hold it *down* . . . or pull it *sideways. In fact, wherever you have a job calling for a firm grip on anything cylindrical—from only 1⅛" in diameter to 21"—the Baash-Ross Safety Clamp will probably do the job easier than you ever thought possible!*

HERE'S THE GRIPPING PRINCIPLE IN A NUTSHELL

The Safety Clamp consists essentially of many individual links flexibly hinged together. Each link has a tapered slip held in retracted position by a spring. When the Clamp is tightened around the pipe—a quick and simple operation—each slip takes a firm initial grip on the surface of the pipe. As the load increases, each slip is wedged tighter, preventing any slippage between pipe and Clamp. There's no risk of crushing thin-walled pipe or damaging pipe surfaces because the grip is *uniformly distributed around the full circumference.* And since each link is interchangeable as a unit, simply adding or removing links readily adapts the Clamp to virtually any diameter pipe in common use.

Baash-Ross Safety Clamps are available through leading oil field supply dealers.

Few bottomhole pressure tests have been made in either field since water encroachment has become so severe an operating problem. The fact that some wells still flow naturally in both fields with high water-oil ratios and other wells have working fluid levels below 2000 ft indicates that the producing sections of the reef limestone are not always well connected with each other or with the main aquifer that is flooding the reservoir.

Water and Oil Production

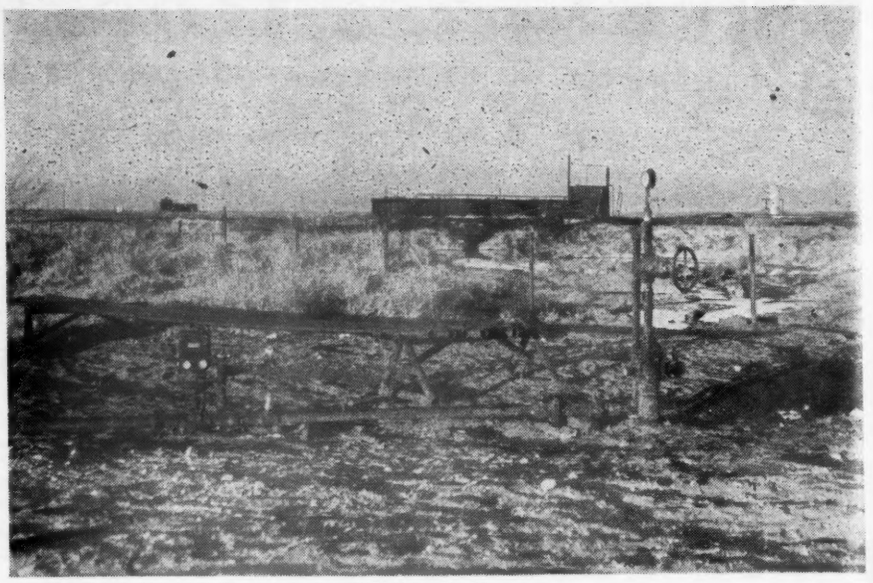
The discovery well in Hendrick was only about 50 ft above the edge of the structure on the south side of the field. It produced about 700,000 bbl of oil in the first 15 months, and this without producing water, although water had already appeared in huge quantities in some of the wells situated higher up on the structure. It is true, of course, that more oil had been produced by the higher wells, so the excessive water production was probably due to "fingering", "coning", or channeling toward the large wells.

Many wells were producing as much as 99 per cent water in 1928, the year of peak oil production (see Table 1), and some wells produced as much as 20,000 bbl of water and only 50 bbl of oil per day in 1930. The average water production in 1932 was reported to be 98 per cent for the field as a whole. Water production at the present time is estimated to be in excess of 99 per cent although it is not measured very closely.

The meager data available on water production from the Hendrick field since the beginning indicates that at least 98 per cent of the production has been water, which means that more than 11,000,000,000 bbl of water have been produced along with the oil.

As the Henderson field was developed and produced at a much slower rate than Hendrick, because of smaller wells and proration restrictions, water production did not become excessive until about 1944, the year of peak oil production. The wells flooded out rapidly, however, and are now producing about 97 to 99 per cent water. Cumulative water production from this field is estimated to be in excess of 600,000,000 bbl through 1950.

Fortunately, the water produced from the wells in these fields is not very salty and is not harmful to most animal and vegetable life. It is a sulfurous mineral water that is more of a nuisance than a menace. Two companies built a system of canals for disposing of it in a low place now known as Wink Lake, which is reported to be a good fishing spot. Other operators dispose of the water production in large evaporation pits.



This well in the Henderson field produces about 35 bbl of oil along with 3500 bbl of water per day by injection of about 115,000 cu ft of gas at 500 psi into the annulus between the 5½-in. casing and the 2-in. tubing.

The annual production of oil from these two fields is shown in Table 1. Some 620 producing wells have been drilled in the Hendrick field to obtain the 220,000,000 bbl of oil produced so far, which is a cumulative average production of more than 350,000 bbl per well, or 18,350 bbl per proved acre. More than two-thirds of these wells have now been abandoned, and may of those remaining are temporarily abandoned or producing little more than enough oil to pay for their continued operation. In fact, some wells are being produced mainly to slow down the encroachment of water in nearby wells, which might "drown out", if the offsetting wells were shut down or abandoned. In general, the wells that produce the most fluid also produce the most oil, and they also regain their oil production faster after being shut down for a repair job.

About 140 producing wells have been completed in the Henderson field to obtain the 13,350,000 bbl of oil that has been produced thus far. The average cumulative is about 97,000 bbl per well and about 4770 bbl per proved acre. More than one-half of the wells have now been abandoned, and some others are temporarily abandoned or shut down. Here, again, the wells that are capable of producing the most fluid are generally capable of producing the most oil. Wells that pump from 800 to 1200 bbl of fluid per day may produce as little as 3 bbl of oil. Some such wells have been placed on gas lift or bottomhole electric pumps and produced 3000 to 4000 bbl of fluid with 30 to 35 bbl of oil, indicating a substantial gain in oil percentage at a higher producing rate.

Corrosion Problems

Little corrosion trouble has been encountered in the wells in the Henderson field although the water analyses are about the same as in the Hendrick field, where severe corrosion damage occurs in most wells below 2000 ft. This difference in corrosion trouble in the wells in the two fields is very pronounced. New strings of tubing that have been run below 2000 ft in wells in the Hendricks field have been corroded so badly that the tubing has parted in about 18 months.

Fortunately, the working fluid level in most wells in the Hendrick field is from 700 to 2000 ft, so that tubing need not be run into the zone of severe corrosion. Casing in many of the Hendrick wells was set several hundred feet above the top of the Seven Rivers, leaving open a Bentonitic bed above the pay. Perhaps the caving of the Bentonite had something to do with the severe corrosion encountered on the outside of the tubing that was run deeper than necessary.

Casing Pumps Used

A good many of the wells in the Henderson field are equipped with individual twin-crank pumping units rated for from 15,000 to 20,000 lb polished rod loads. These are operated by 35 to 40-hp multicylinder gas engines at 20 to 24 54-in. strokes per min using 1-in. rods and 5½ × 3¾-in. casing pumps set about 2000 ft. The working fluid level ranges from 800 to 1600 ft. Such installations produce from 800 to 1200 bbl of fluid per day and have not been troubled with corrosion. ★ ★ ★

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OIL BASE DRILLING FLUID

These two offsets, drilled on a California lease in 1940 by a major oil company, were similar in every detail. They were drilled to the same reservoir within a few hundred yards of each other. Their logs and cores showed a close relationship from top to bottom. Only on one known factor did they differ: Well A was completed with a water base mud while Well B was completed with an oil base mud.*

On October 10, 1940, the first Specific Productivity Index was .00611. On April 11, 1947, 6½ years later (the date of the last reading), the SPI was .00132. It had dropped to 21% of its original pressure. Total production during this 78 month period was 256,000 bbls., an average of 3285 bbls. a month.

The first SPI taken on September 24, 1940, was .00789. On August 19, 1947, the SPI was .00294. In 83 months it had declined to 37% of its original. Total production was 487,500 bbls., a monthly average of 5875 bbls., an increase of 2590 bbls. every month over Well A.

NOTE THE SIMILARITY OF THESE OFFSET WELLS

	WELL A	WELL B
Sand Thickness	180 ft.	190 ft.
Average Sand Permeability	115 md.	105 md.
Static Pressure	3135 psi	3100 psi
Millidarcy feet of sand	20,700	19,950

* The oil base mud used in this well contained air-blown asphalt and was mixed with a refined type oil. After several improvements this mud became known as Black Magic.

BLACK MAGIC ASSURES MAXIMUM RECOVERY

These wells were produced under proration conditions and represent normal depletion practices. In spite of the fact that Well A flowed an average of 3285 bbls. monthly, it still was producing far below its ultimate potential due to Jamin action (water blocking), the result of drilling into the production zone with water base muds. The difference in the size of Wells A and B proves beyond question that water blocking damages a well permanently, hastens the day it will be shut down.

Black Magic with a filtrate loss of zero cannot possibly mud off or water block the oil sands. Black Magic deposits a thin mud cake that readily disintegrates when displaced by crude. It helps instead of hinders production and on occasion has made commercial producers out of dry holes. For full information write for paper "What Happens Tomorrow?"

OBI PRODUCTS also include WHITE MAGIC oil emulsion mud; OB GEL to increase Black Magic viscosity; OB GEN to regenerate water-contaminated Black Magic; OB WATE weighting material; OB HEVYWATE, barites; CHEMICAL "V" regenerates crude contaminated Black Magic; CHEMICAL "X" reduces its viscosity; OB MIX FIX corrects a faulty mixing oil; OB ZERO lowers fluid loss; OB MUD GUNS; OIL BASE HAND CLEANER. Write for a free copy of the Oil Base, Inc. Handbook containing useful information on muds and drilling equipment.

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NEWS

New Oil Production Discovered in Chili

The Chilean Government's oil organization has discovered oil in the Cerro Sombrero area about 10 miles southeast of Cerro Manantiales field. A second well in this area was reported to have been brought in flowing at a rate of about 300 bbl daily. Crude was reported to be similar to the 39-42 gravity oil obtained in Cerro Manantiales. Production from the new well is being taken out by trucks at the present time, but plans are being made to lay a line connecting the field with the line from Cerro Manantiales to the tanker shipping terminal on the Straits of Magellan at Caleta Clarencia. This is the second well completed in this area.

Cerro Manantiales in Tierra del Fuego near the southern tip of Chile was discovered in 1945 as the country's first oil production.

Illinois Oil Data for 1949

The Illinois Geological Survey has published a booklet titled "Oil and Gas Development in Illinois in 1949," by Alfred H. Bell and Virginia Kline. The booklet states that Illinois produced 64,583,000 bbl of oil, or 3.5 per cent of the total for the U. S., and ranked sixth in the country for the seventh consecutive year last year. Production was approximately the same as that of 1948. Other pertinent data on the Illinois petroleum industry in 1949 are included.

Hancock Oil in Midland

Hancock Oil Company of California has opened a new division office in Midland, Texas. This was done preparatory to a New Mexico-West Texas drilling campaign. Landman is Hugh Story and L. S. Melzer, formerly with Stanolind's district geological department, is in charge of the geological department. Ray Preece is division manager.

Continental Establishes Casper, Wyoming, Office

Continental Oil Company has set up a new district office in Casper, Wyoming for operations in the Sussex, Lance Creek, and Big Muddy fields. Personnel transferred from Lance Creek to staff the new office are Earl Y. Long, district engineer; J. W. Denny, district superintendent; C. E. Robertson, district clerk, and R. C. Bartels, assistant district superintendent with headquarters in Big Muddy. The new office is in the Star Building in Casper.

Geologists Urged to Use Imagination in Hunting Oil

"Hydrocarbons will still be used 50 years from now to heat a house and run an automobile, and the oil industry will still be furnishing the fuel, whether it comes from crude oil, shale, coal, or corn stalks!" That was the prediction of Ira H. Cram, Continental Oil Company vice president in charge of exploration and production, Houston, when he opened the annual Fort Worth regional meeting of the Society of Exploration Geophysicists.

Cram advocated "drilling more wildcat wells on more imaginative prospects." Citing the relentless hunger of the country for petroleum products, the Continental exploration executive declared that it is not a matter of whether or not the industry "can" afford more imaginative wildcatting—"it must afford it." Because the demand for oil is expanding so greatly each year, reserves must be found at a comparable pace, he reminded.

Consulting Firm Set Up

Charles H. Pishny and Walter Berger have formed a consulting firm, Berger and Pishny, with offices on the ninth floor of the Commercial Standard Building, Fort Worth, Texas. The new firm will engage in consulting, valuations, and geological work in the oil business.

Guests of Los Angeles Nomads. Foreign guests attending the Los Angeles meeting recently were: Seated, F. H. Kopp, Iraq Petroleum; R. J. Kettenburg, Asiatic Petroleum; R. E. Johnson, Anglo-Iranian Oil; E. J. Turner, Arabian American. Standing, C. D. Schultz, Arabian American, L. W. Evinger, CIMA, Mexico; R. C. Enwall, Arabian American; W. T. Irvine, Anglo-Iranian Oil; C. C. Sutten, Caribbean Petroleum, and F. G. West, Asiatic Petroleum. Stewart McClellan, Wilson Travel Agency, was the speaker.

Seated, Guy Daniels, Guy Daniels Company; William Riggins, Hydrill Company; Herb Maland, R. J. Eiche and Associates, and E. T. Landgraff, Chiksan Company. Standing, Jack Walpon and Val Wittich, International Derrick and Equipment, and E. W. Mayo, World Petroleum.

NEWS

Sinclair, B-A Enter Pact

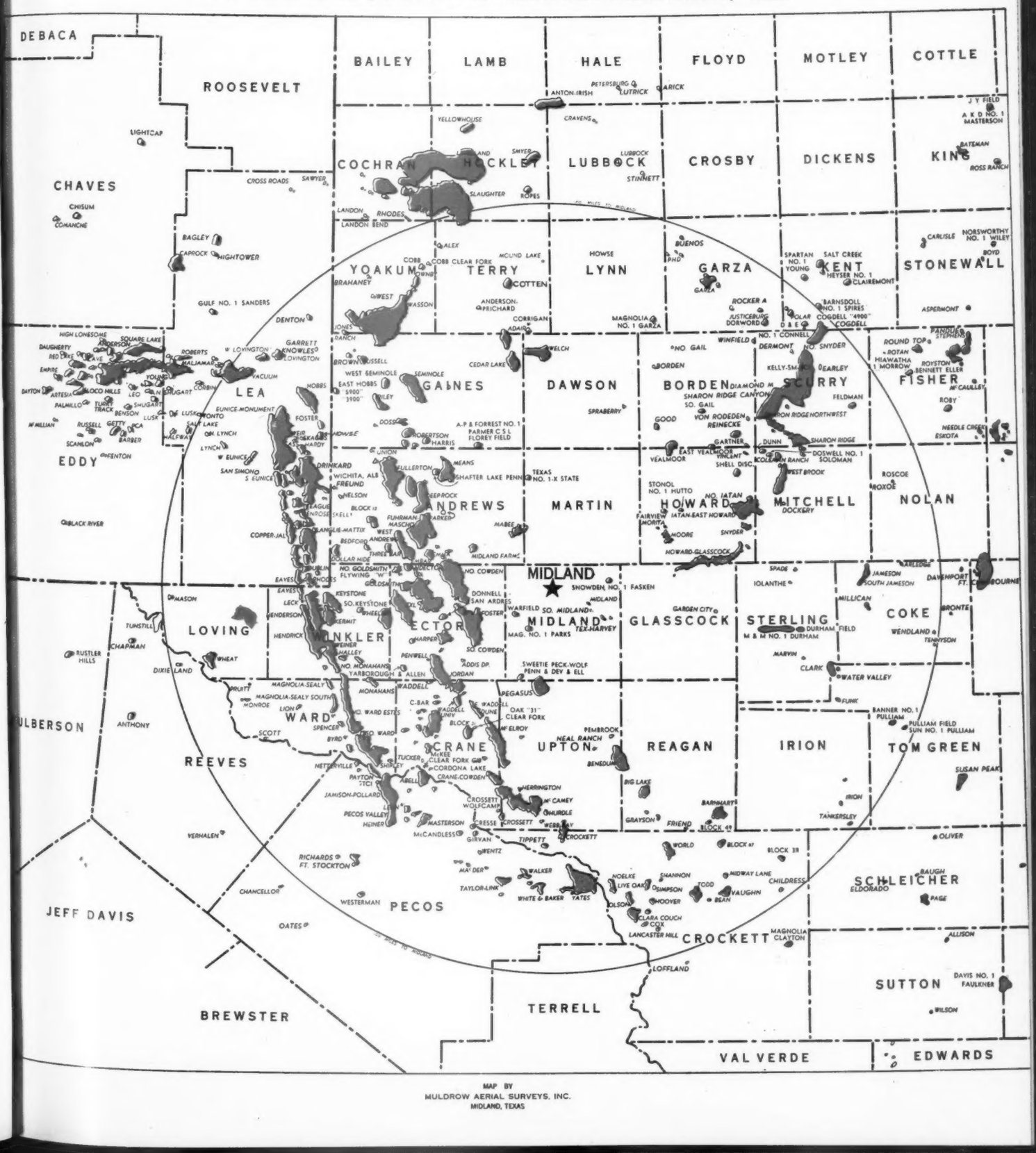
Sinclair Oil Corporation, through a subsidiary, Sinclair Canada Oil Company, has entered into an agreement with the British American Oil Company, Ltd., for a joint exploration program covering an area of about 900 square miles in the Province of Alberta, Canada, in the vicinity of Edmonton. As an initial step, two seismograph crews have been employed under the joint direction of the two companies, which share equally the expenses of these operations.

Under the terms of the agreement, either of the parties may act independently of the other in acquiring oil and gas leases, but in the event of such acquisitions by one company the other party has the right to participate equally in any such acquisitions. Sinclair has the option to elect to participate in leases already held by B-A.

Renew Prospecting Grants

The English minister of fuel and power has renewed for a further period of 12 months two prospecting licenses granted under the Petroleum Act, 1934, and the Petroleum (Production) Regulations, 1935, to (1) The Anglo-American Oil Company, Ltd., covering an area of about 12 sq miles in Midlothian County. (2) The D'Arch Exploration Company, Ltd. for about 142 sq miles in the counties of Derby, Leicester, and Stafford.

Recent map of oil and gas fields in the Permian Basin around Midland, Texas.



MAP BY
MULDROW AERIAL SURVEYS, INC.
MIDLAND, TEXAS

WHAT'S DOING IN DRILLING

Beckham Sector Gets Two Good Producers

Two good oil and gas producers have been completed in the Beckham County sector of the Elk City field, Oklahoma, by Shell Oil and Shell and Continental Oil Companies. Shell's No. 1 Kinney flowed 606 bbl of oil with 1,099,000 cu ft of gas in 24 hr through a 22/64-in. choke. It has been plugged back to 10,000 ft. Shell and Continental's No. 3 Cantrell flowed 623 bbl of oil with 4,742,000 cu ft of gas in 24 hr through a 22/64-in. choke. It's plugged back depth is 10,124 ft.

Second Strike Made In New Mexico Area

Magnolia Petroleum Company has completed its O'Brien 1-B in Chaves County, New Mexico, as a second discovery in the area. Between 7234-7249 ft, the well tested 121 bbl of 52.4 gravity oil in 2¾ hr through ⅝-in. bottom hole and 1-in. top choke. The well, 9¼ miles southwest of the Lightcap discovery, was completed as an extension.

Pegasus Field Extended

Ellenburger production is being extended in the Pegasus field, Midland County, Texas, with the No. 1 Joe Canon. Drilled by Clint W. Murchison, the well showed for an oil producer on a drillstem test at 13,100-52 ft. On the test, tool was open 5 hours and gas hit surface in 74 minutes. Stem recovery was about 5500 ft of 50.9 gravity oil. The well topped the Ellenburger at 13,122 ft (minus 10,233), about 125 ft low to the nearest Pegasus well, but believed still 130 ft above the water level.

Coastal Dome Adds Well

McCarthy Oil and Gas Corporation has completed a prolific oil well in the Big Hill dome, Jefferson County, Texas. The company's No. 1-B Davidson Estate flowed 214 bbl of oil daily through an 8-in. choke from 8424-32 ft. Gas-oil ratio was 1044 to 1. Total depth was 11,417 ft.

Bay Well Successful

Bay Petroleum Corporation's No. 2 Carpenter in Carter County, Oklahoma, flowed oil at a rate of 100 bbl an hour on a drill stem test between 4456-4504 ft. With tool open 26 min, gas showed in 2 minutes and oil in 12 minutes. It is drilling ahead.

Humble Completes Well In Alabama Field

Humble Oil and Refining Company has completed the second well in the Clarke County, Alabama, in South Carlton field. The No. 2 J. H. Wall Estate was completed for 80 bbl of 13.7 gravity oil per day on pump through perforations, at 5317-22 ft. It is believed this is a sand slightly higher in the lower Tuscaloosa section than the sand from which the discovery well was completed.

Tries for Wilcox Flow

Southern Production Company is preparing to set 7200 ft of 5½-in. casing at its No. 1 George Armstrong to test for production from the Wilcox. The well is situated in Carthage Point field, Adams County, Mississippi. Carthage Point field produces from the lower Tuscaloosa, although Wilcox shows have been reported in several wells but found unproductive.

B-A Well Productive

British-American Oil Company has completed a substantial oil producer on Moss Bluff Dome in Liberty County, Texas. The initial well, British-American McFaddin No. 1, produced 132 bbl of 30 gravity oil through a ⅛-in. choke in its first 24-hour test. In the drilling of this well other possible pay zones totalling approximately 100 ft were cored, with final completion of the well being made at a total depth of 5864 ft.

Indiana Field Adds Well

Graham Development Corporation has discovered a second producing zone in the City North pool, Knox County, Indiana. It is the company's No. 3 Meyers, which has been drilled to the Rosiclare lime. Previous wells in the area have produced from the Aux Vases zone. The Aux Vases zone is about 1500 ft deep.

Illinois Field Gets New Production Zone

The new Ellery West area in Wayne County, Illinois, has a third potential production zone at Aurora Gasoline Company and N. V. Duncan's No. 1 Fisher Community. Good saturation was found in the Aux Vases and the Rosiclare. Saturation in the former was logged at 3223-41 ft and in the latter at 3322-30 ft.

Memphis Petroleum Drills Well in Abandoned Field

A pumping well has been completed in the old abandoned Cary field of Sharkey County, Mississippi by the Memphis Petroleum Corporation. It is the No. 1 Houston, which pumped at the rate of 70 bbl of 25-gravity oil and 2175 bbl of salt water per day. Hole was drilled with rotary tools to 3254 ft and 7-in. production casing run to total depth. The well has been testing on pump for several weeks pumping a high volume of salt water making it uncertain whether continued operations will prove profitable.

Activity Increased in Two Oklahoma Pools

Stephens County, Oklahoma's Sholem Alechem field has a prolific well, which has just been completed by Stanolind Oil and Gas Company at its No. 1 Humphrey-B. The crew swabbed some 650 bbl of 28 gravity oil in 24 hr. Plugback depth is 5641 ft.

In the same county, Gulf Oil Company has recovered a large amount of oil on a swab test on its No. 1 Martin. Situated in the North Milroy pool, the crew swabbed 421 bbl of oil in 20 hr. Total depth is 6300 ft, and gravity is 27.8.

Mississippi Field Well

The Kingston field of Adams County, Mississippi is the scene of a second producer. Magnolia Petroleum Company's No. 1 Tver-Swayze Unit has been completed at the rate of 228 bbl of oil per day through 12/64 in. choke. It is the south offset to the discovery producer for the field. Production is being obtained through casing perforations placed 6637-40 ft opposite the Walker sand from which the discovery well was completed. Tubing pressure was 350 lb and casing pressure 240 lb with a gas-oil ratio of 300 to 1.

Michigan Well Successful

Dunningville Traverse field in Allegan County, Michigan has its second well. P. K. Degenther drilled the first well following the discovery and this test was pumping and flowing oil at the rate of 15 bbl an hour natural. It was reported to be producing an average of 100 bbl of oil a day. Oil was discovered at 1433 ft, a foot or more higher in the section than the best producing area in the discovery well.

IT TAKES

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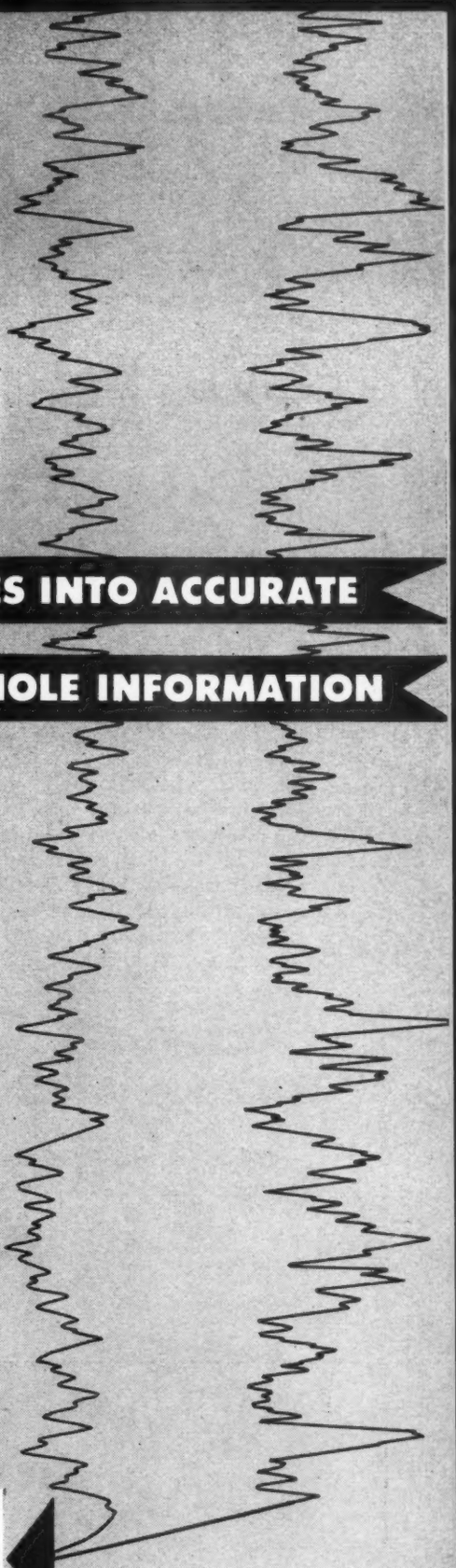

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AR-401

Papuan Well Deepened

The Australasian Petroleum Company has reported that the bore at Wana in the Delta Division, Papua, has been deepened 727 ft from 7308 to 8035 ft. Trouble-free conditions are evidently persisting, as the drilling rate is still high. Island Exploration has commenced rig erection at Omati, also in western Papua. At Horo, the rig site for No. 2 tests has been levelled in preparation for the transfer of the deep-drilling outfit—first used for the drilling of the 12,621-ft well at Kariava—from the No. 1 drilling location. It will be recalled that the No. 1 Hohoro well was abandoned at 4721 ft in July owing to the difficulty and complex geological subsurface conditions encountered.

Deepest Well Drilled In Glenmora Field

Texas Pacific Coal and Oil Company has completed the deepest well in the Glenmora field in Parides Parish, Louisiana. It is the company's No. 2 J. A. Bently, which was bottomed at 11,709 ft in Midway shale. Casing was perforated at 11,169-73 ft, in a basal Wilcox sand. Initial flow was 107 bbl of oil in 14 hr through 1/64-in. choke. Tubing pressure was 1900 psi and shut in pressure was 2200 psi.

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Oklahoma Field Has New Producing Zone

Woods-Gilchrist, an associate of Woods Drilling Company, has opened a new producing section in the West Norfolk field in Payne County, Oklahoma. The company's No. 2 Hill hit the known zone, the Peru sand, at 2798 ft, and perforated the new sand, Cleveland, between 2553 and 2557 ft. Following hydrafrac treatment, well flowed 60 bbl of oil in 15 hr through a 14/64-in. choke. Now testing the Peru sand, the crew said the well will probably be completed as a dual producer.

Mounds Field Adds Producer

Charles H. Hartman, independent producer at Sapulpa, Oklahoma has a new producer for Mounds field in northern Okmulgee County, Oklahoma. The No. 1 Irby et al was drilled to the Dutcher sand at 2120 ft, and 2148 to 2166 ft. Drilling was then resumed to the Mississippi lime, encountered at 2263 ft and in a few feet it filled 1000 ft with water. When the water was finally exhausted, the Dutcher sand level opened and filled 1000 ft of oil into the hole. The fill-up was estimated at 40 to 45 bbl a day natural.

Gulf Opens New Sand

Gulf Refining Company has opened a new producing sand in the Lake Misere field, Cameron Parish, Louisiana, with completion of its 1-H Miami Corporation. The well flowed 38 bbl of 44.6 gravity oil daily through a 12/64-in. choke plus 2,415,000 cu ft of gas from 9947 to 9956 ft. Tubing pressure was 3600 lb and gas-oil ratio was 63,500 to 1.

Fourth Producing Zone

A fourth producing production has been found at Amerada Petroleum Corporation's Caudle 2, in Bagley-Hightower-Pennsylvanian pool, in northwest Lea County, New Mexico. On a test between 9338-9390 ft, open 4 hours and 40 min, gas was recovered in 4 min, at the rate of 1,310,000 cu ft per day. Mud surfaced in 20 min. Oil followed in 10 min and flowed 61.96 bbl in 4 hr.

Elk City Pool Adds Well

Shell Oil Company has added another producer to the Elk City pool in Beckham County, Oklahoma with its No. 3 Smith-B. The new well expanded Hoxbar conglomerate in the Beckham County field. It flowed 369 bbl of 56.2 gravity oil with 2,877,000 cu ft of gas in 24 hr through a 22/64-in. choke from perforations at 9905-85 and 10,035-55. Plug-back depth is 10,093 ft.

Makes Dual Completion In Sweetie Peck Field

The No. 1 Josie Faye Peck in the Sweetie Peck field Midland County, Texas has been dually completed by Benson-Montin, Inc. The well is producing from the Fusselman and the Ellenburger. From the former it flowed 240.73 bbl of 50 gravity oil daily after acidization through perforations from 12,505-55 ft. And from the Ellenburger at 13,160-300 ft for 731 bbl of 52 gravity oil daily. Gas-oil ratio is 849-1.

Extension Well Flows 299 bbl of Oil Daily

Delta Drilling Company's No. 1 S. M. Taylor has extended the Southeast Pickton field 2 miles in Hopkins County, Texas. A completion gage of 299.37 bbl of 49.5 gravity oil daily has been reported. Flow was through 1/4-in. choke with gas oil ratio of 1650 to 1. Drilled to 7930 ft, the well is producing from perforations at 7884-97 ft.

Abandon Nevada-Utah Well

A decision to abandon drilling efforts on the first deep well to test the Nevada-Utah Basin and Range Province has been announced by partners in this joint oil exploration, Standard Oil Company of California and Continental Oil Company. The joint venture well, Maridian No. 1, was begun several months ago in White Pine County, about 42 miles west of Ely, Nevada. The well was carried down to 10,314 before being abandoned, although a small oil and gas show was indicated at about 3000 ft.

Saudi Arabia Output Down in November

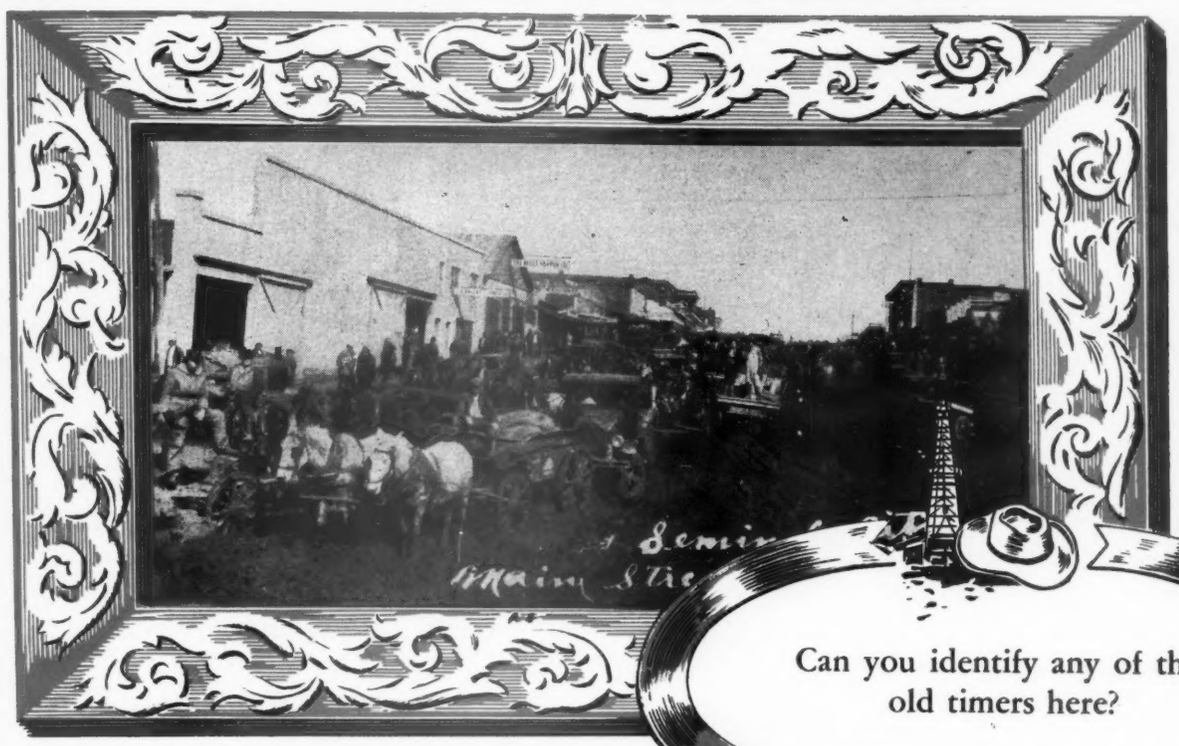
Crude oil production in Saudi Arabia during November amounted to 18,602,809 bbl, or an average of 620,094 bbl per calendar day, it was announced by the Arabian American Oil Company. Crude oil production in October amounted to 19,937,556 bbl, or an average of 594,871 bbl per calendar day.

Crude oil production for the first 11 months of 1950 amounted to 180,392,599 bbl, an average of 540,098 bbl per calendar day.

Nevada Well Abandoned

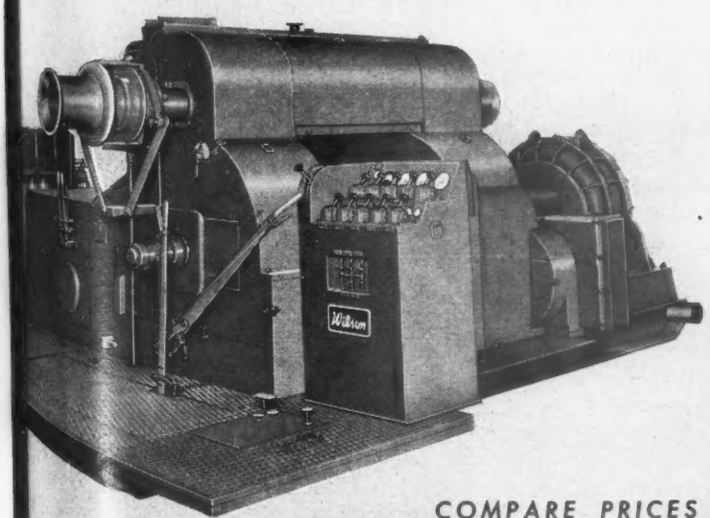
Standard Oil Company of California has drilled its Unit No. 1 on the Meridian Unit, White Pine County, Nevada, to 10,300 ft. The well will be abandoned, though slight shows were found. Joana limestone of Mississippian was topped at 3600 ft; Pilot shale at 3676 ft, and Devonian at 3970 ft.

REMEMBER SEMINOLE?



Can you identify any of the old timers here?

We will probably get picturesquely profaned for this. No present day Seminolian would ever believe the Main Street of their fair city once looked like this. Shawnee or Wewoka, maybe, but not Seminole! Strange as it may seem, this is Seminole in the Boom Days.



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EXPLORATION ACTIVITIES

Mexican Oil Industry Aided by New Discoveries

Four new oil areas have been discovered in Mexico recently, according to Sen. Antonio J. Bermudez, director general of Petroleos, Mexicanos, the Mexican government petroleum administration. First in importance was an extension to the El Plan field in Vera Cruz, where three wells have been completed as producers, with a net initial production of more than 3500 bbl daily. Rated second was a wildcat discovery in Tancoco, Vera Cruz, which has brought in an initial flow of 315 bbl daily, and it is believed that more prolific production is assured from a deeper formation. Geologists believe that a group of new producing areas may be found along a line parallel to the famous Golden Lane.

Third in importance was the discovery of a prolific new oil horizon in the Monterrey field of Tamaulipas, which resulted in an initial oil flow of 315 bbl daily, and enlarged the potential in this field, as well as in other structures in northeastern Mexico. The field has hitherto been a gas producer.

Fourth discovery was a potential new wildcat oil producer near Tuxpam, Vera Cruz, according to Bermudez, where a good showing of oil and gas in test drilling has given evidence of possible commercial production in zones still to be tested.

Kentucky Oil Area Opened

R. E. Hupp et al's No. 1 John O. Sawyer has opened a new oil producing area in Henderson County, Kentucky. Total depth of the well is 2383 ft. A one-hour drill stem test, the well recovered gas in one hour, 720 ft of clean oil, and 30 ft of oil cut mud. This well is four miles from other oil wells and opens a new area.

Dakota Oil Interest High

A reported oil strike 3 miles north of the Botineau County, North Dakota line has caused increased interest in that section of the country. Souris Oil Company has reported an oil strike in southern Manitoba, Canada. It is said to have pulled a saturated core in Madison limestone at 3221-27 ft, but testing tools were stuck in the hole. The wildcat, which is semi-tight, is drilling on a big block with the Devonian being the objective.

Colorado Oil May Be New Oil Discovery

The United States producing subsidiary of The British American Oil Company Limited has made what appears to be an important new oil discovery in Logan County, Colorado, at the British-American Koenig Ashby No. 1 well. This well flowed 20 bbl per hour of 40 gravity crude, with no water, at a total depth of 5250 ft. On its first 24-hour test the well produced 425 bbl of oil and no water.

Arkansas Has New Field

Stanolind Oil and Gas Company's A-1 Miller Land and Lumber Company in Miller County, Arkansas has opened a new field for that state. The wildcat is flowing 200 bbl of 38.2 gravity oil daily plus 25 bbl of salt water from Rodessa perforations at 6303-12 ft with a gas-oil ratio of 1300:1 and working pressure at the surface of 275 lb. Location is 4 miles north and three miles east of Bright Star. Total depth is 6515 ft.

Kansas Oil Pool Discovered

Alladin Petroleum Corporation and Crowe Drilling have completed their well No. 1 Kultgen, in Barton County, Kansas. The well, which opened a new oil pool, was completed for a daily potential production of 118 bbl. Alladin and Crowe have completed the well in the Lansing-Kansas City from 3115 to 32 after plugging back from Arbuckle and acidizing. It opens the Cheyenne View-North field, which is ¾ths of a mile north of the Cheyenne View area.

Test Alabama County

A wildcat test has been begun in Baldwin County, Alabama by Gulf Refining Company. The well is the No. 1 B. D. Simison et al. Twenty-inch conductor pipe has now been cemented at 105 ft and drilling is continuing below 275 ft.

Coast Opener Successful

A wildcat, which has created much interest on the Gulf Coast of Texas, has been completed successfully. It is Cox and Hamon's No. 1 Hughes, Miller League, which flowed 200 bbl of 36 gravity oil daily through 7/64-in. choke from 9365-69 ft. Tubing pressure was 1230 lb. Drilled to 9713, casing was set at 9494 ft.

Natural Gas Discovery Made in Canadian Area

Canadian Delhi Oil Limited, has another natural gas strike in the Royal Park area of central Alberta, about 30 miles northwest of the Viking-Kinsella gas field, Canada. The well is Shultz-Royal Park No. 1, and has found natural gas during drillstem tests in the Lower Cretaceous. On a drillstem test from 2232 to 2247 ft, a maximum natural gas flow rate of 2,820,000 cu ft daily was discovered. Next test, from 2575 to 2595 ft, gave a flow rate of 360 cu ft daily during a one-hour test.

Reef Strike Made

Continental Oil Company has a prospective discovery in the northeast corner of Garza County, West Texas at its No. 2 Swenson Land and Cattle Company, in an area where earlier tests had promising reef showings. The well had the Canyon at 6843 (minus 4484) and was drill stem tested for 75 min at 6835-62 ft. On the test gas showed to surface in 45 min, and stem recovery was 1260 ft of oil and 540 ft of mud cut heavily with oil and gas. Flowing pressure was 285 to 400 lb.

Tulsa Well Producing

Within 70 ft of the Tulsa, Oklahoma city limits, an oil well is making 25 bbl of 38 gravity oil a day. It is in the Garden City area across the Arkansas river from Tulsa city proper. It is T. Maxwell Anderson, E. A. Rogers et al No. 1 George C. Schmidt, and was drilled to the shallow depth of 1520 ft. Bottomed in the Dutcher sand, the new producer fills up about 800 ft with oil overnight and, at times, makes flows by heads at a rate of about 20 bbl of oil a day in these flows.

Montana Discovery Well Pumps 222 bbls in 24 hr

Farmers Union Central Exchange's Sawyer No. 1, which is a Heath sand discovery in Rosebud County, Montana, produced 222 bbl of 31.6 gravity, gassy oil the first 24 hr it was on pump. This well, one of the best discovery wells ever drilled in Montana, has revived interest in the area between Ragged Point and Porcupine Dome. Gas pressure is strong enough to hinder pumping and causes the well to head up and flow at intervals.

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Heavy Gas Flow Found in Utah

The California Company has drilled an exploratory well in southwestern Unitah County, Utah, where a heavy flow of natural gas has been found. The company's No. 1 Unit showed a flow of 4,335,000 cu ft of gas daily, coming from tertiary formations at a depth between 4261 and 4294 ft. The company stated that the well is intended for oil exploration and drilling will be continued. There are no pipe line facilities now in the area.

California Wildcat Well

A California wildcat well has been brought in in Kern County, by Richfield Oil Corporation. The new well, Shields-Arms No. 1, flowed at the rate of 354 bbl of 12.5 gravity oil, 4 per cent cut through at 22/64-in. bean. It was drilled to a depth of 3617 ft and plugged back to 3580 ft, and is producing from the Olcese sand. Present production is 198 bbl a day of 13 gravity crude. Closest production to the well is in the Race Track Hill field, 1½ miles southeast.

Test Sites Anticline

L. O. Tarrant is drilling a new test well on the Sites anticline of north central Colusa County, California, the Nieta Peterson No. 1. Three wells were drilled at other points on the structure during 1923 to 1927, and the gas found was nearly pure methane. The Sites anticline is a chevron type of fold with very steep limbs. Upper and Lower Cretaceous marine sediments are the only rocks penetrated by the old wells or exposed at the surface, so Cretaceous beds are presumed to be the source of the gas. The Sutter Buttes field, situated 25 miles southeast, produces gas from Cretaceous beds.

New Oil Area in Indiana

Tests indicate that a new oil pool has been found in Posey County, Indiana. The discovery well is the Victor Gallagher and Indiana Farm Bureau No. 1 Toran, about 3 miles east of Rising Sun, Illinois. Total depth of the well is 2345 ft, and pipe has been set to test the Waltersburg sand at 2123 to 2135 ft. A drillstem test recovered gas in 47 min and flowed clean oil in 54 min. Bottom hole pressure was 940 lb.

Kansas Pool Opened

Imperial Petroleum Company has opened a new oil pool in the extreme northern part of Kansas. The Phillips County wildcat, No. 1 Vogel, swabbed at the rate of 20 bbl of oil per hour from a depth of 500 ft during a 4-hour period. Production is from the Lansing lime, and is topped at 3128 ft. Total depth is 3150 ft, with casing at 3146 ft.

Sinclair Makes New Find

Sinclair Oil and Gas Company has a new oil discovery in Concardia Parish, Illinois with completion of its No. 1 R. B. Sharp, seven miles south of the Deer Park field. The well flowed 267.8 bbl daily of 43.9 gravity oil on state potential test. Production is from the Wilcox formation at a depth of between 6699 and 6708 ft. Total depth of the hole is 7498 ft.

Colombia Awards Pact On Oil Exploration

The Colombian government and International Petroleum Corporation have signed a 2-yr agreement concerning future exploitation of the Barrancabermeja oil fields, the only fields now producing oil commercially in Colombia.

The agreement, signed by Manuel Carvajal, mines and petroleum minister, and Victor Rose, vice president of International, laid the basis for the creation of the Empresa Nacional de Petroleos (national petroleum enterprise). The ENP will take over the De Mares concession when it reverts to Colombia next August. The Barrancabermeja fields have been exploited by Tropical Oil Company since 1919 under the De Mares concession.

Arkansas Strike Made

Stanolind Oil and Gas Company has opened a new oil producing area in Miller County, Arkansas. It is the company's No. A-1 Miller Land and Lumber Company. The discoverer flowed 200 bbl of 38.2 gravity oil per day. Gas-oil ratio was 1300:1, and working pressure at the surface was 275 psi. Production is from perforations in the Rodessa at 6303-12 ft. The wildcat was originally planned as a 7000-ft test to the Travis Peak, but was bottomed at 6515 ft.

Upton County, Texas Well Flows 111 bbl per Hour

Cities Service Oil Company and Continental Oil Company reported indications of a significant oil strike at their deep University AH No. 1 wildcat in Upton County, Texas. The test flowed at the rate of 111 bbl of high gravity oil an hour during a two hour and 17-min drillstem test of the Ellenberger dolomite from 10,762 to 10,805 ft. The oil is light green in color. On an earlier drillstem test at 10,710 to 10,755 ft, the well flowed at the rate of 80 bbl of high gravity oil an hour. Operators are coring at 10,816 ft in the Ellenberger, which was topped at 10,723 ft.

Spraberry Discovery Made

Standard Oil Company of Texas announces the completion of their No. 1 Mrs. M. V. A. Smith as a new Spraberry sand field discovery in Dawson County, Texas. On initial potential test the well flowed 73 bbl of clean oil in 24 hr through a ⅜-in. choke with a gas-oil ratio of 446 cu ft per barrel. Producing interval is from 7910 to 7983 ft. The discovery well is 10 miles northeast of Lamesa. Nearest Spraberry sand production is approximately 25 miles to the south.

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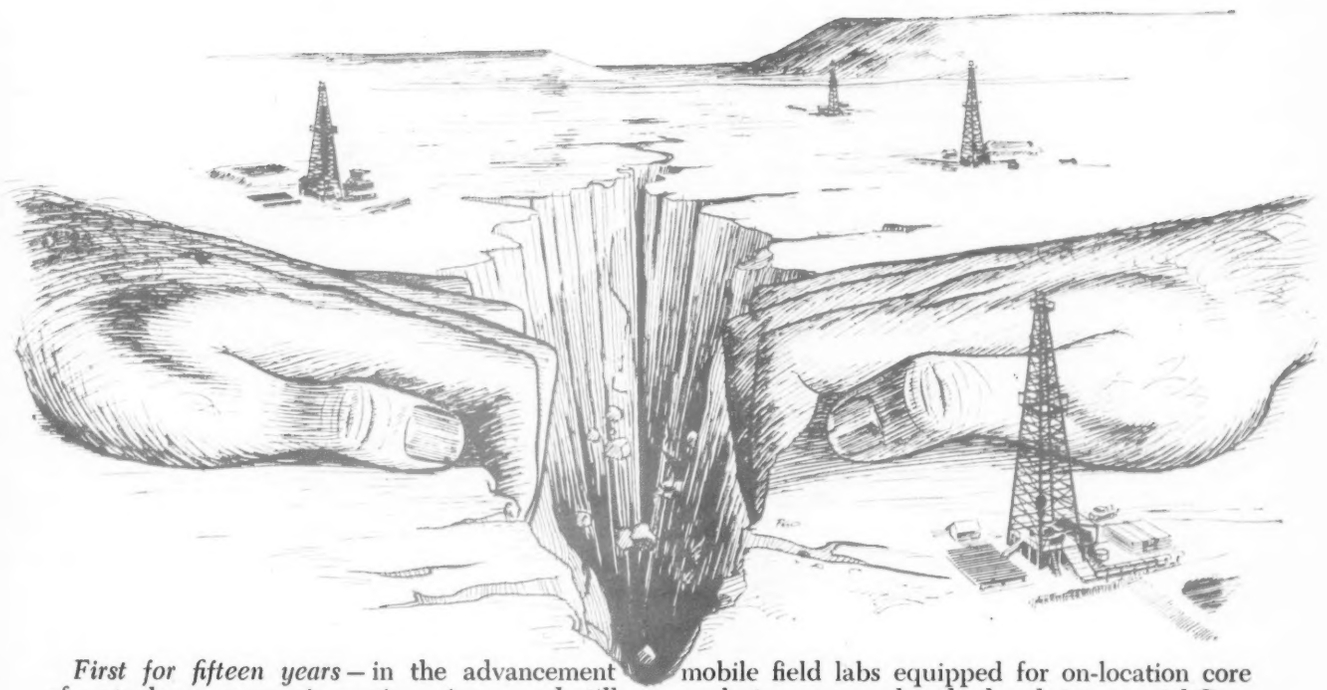

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CORE LAB

PETROLEUM RESERVOIR ENGINEERING

Running tour with men in the industry

▸ **H. H. Arnold Jr.** of Denver, Colorado, division manager, The Texas Company, Rocky Mountain division, producing department, has been promoted to assistant to manager, producing department, and will be stationed at Houston, Texas. **Tom T. Freeman** has been advanced from assistant division manager to division manager, Rocky Mountain division, succeeding Arnold.

S. A. Berthiaume, senior geologist, manager's staff, has been appointed assistant division manager, Rocky Mountain division, and transferred from Houston to Denver.

Arnold attended Colgate University and is a graduate of the University of Pittsburgh School of Mines. He was employed by The Texas Company at Houston in the geophysical department in 1927. Freeman, new division manager with headquarters in Denver, attended the University of Colorado and was graduated from Massachusetts Institute of Technology with the B.S. degree in mechanical engineering. He began with Texaco as storekeeper at the Casper Works (refinery), Casper, Wyoming, in 1922. Berthiaume, a graduate of the University of Washington with the B.S. degree in geology, studied at the University of California and at Cornell University, where he received his Ph.D. degree. He joined Texaco at Houston in 1940.

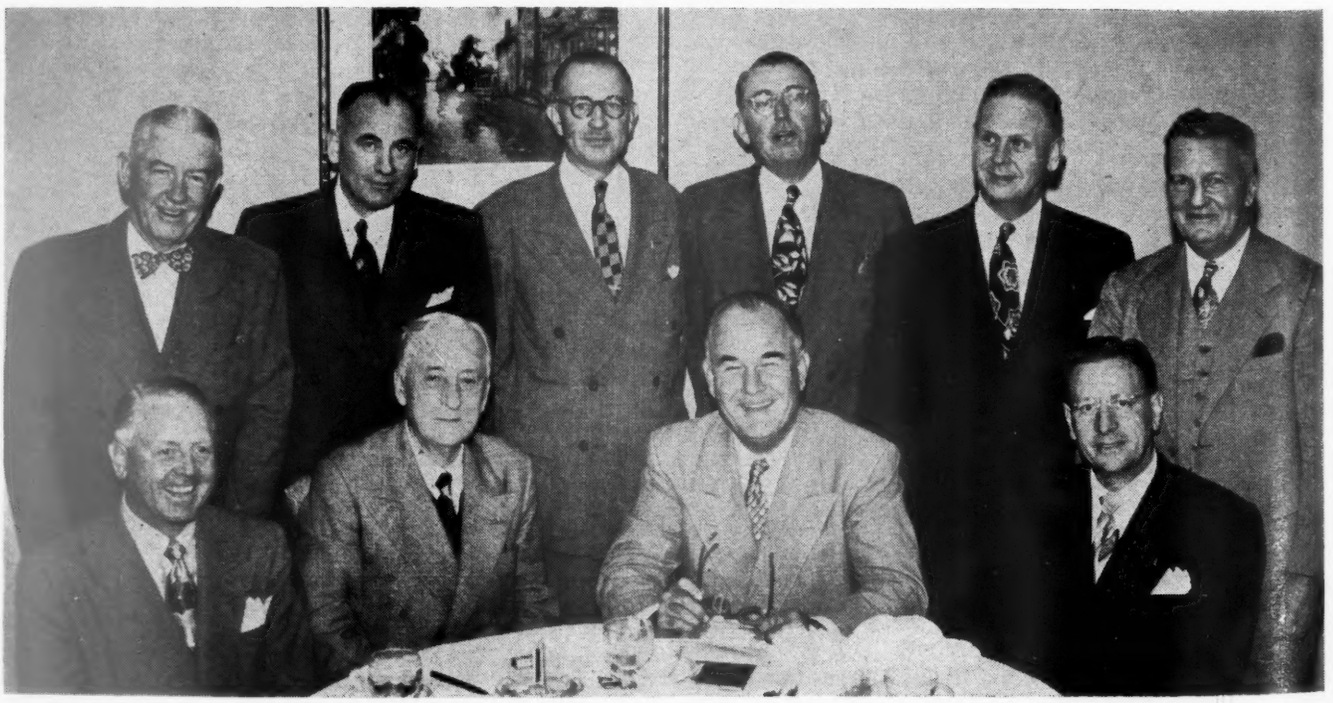
▸ **L. M. Swayze,** who has been active as an independent oil lease broker in the Southwest since 1942, was appointed assistant to Deep Rock Oil Corporation's land manager **F. E. Swenson.** A native Kansan, Swayze entered land and lease work in Tulsa and migrated to south Arkansas just before the El Dorado field was discovered and joined the Humphries Oil Corporation. He returned to Tulsa in 1921 to work for the Red Bank Oil Company, an association that continued for 10 years.

In 1931 he embarked on his first tenure as an independent trader which lasted 4 years, then he joined the Fohs Oil Company in Houston, to head its land and lease work for 7 years.

▸ **W. L. McClusky,** M. J. Delaney Company, Dallas, Texas has been elected chairman of the Dallas-Fort Worth Chapter of American Association of Oilwell Drilling Contractors. He succeeds **F. W. Brigance,** Rowan Drilling Company, Fort Worth. **C. D. Smith,** McQueen and Clevenger, Fort Worth, was elected vice-chairman of the chapter and **Kye Trout,** AAODC, Dallas, was elected secretary and treasurer.

▸ **Thomas Pennington, Jr.,** Humble Oil and Refining Company, marine equipment engineer of the Houston, Texas, office, has been transferred to the petroleum engineering division as senior supervising petroleum engineer. **Fred W. Stover,** compressor plant foreman, Seeligson compressor plant, has been promoted to gas plant superintendent at the Clear Lake gasoline plant. **J. W. Workman,** assistant cycling plant superintendent. Katy gas cycling plant, has been transferred to the Trawick gas system as district gas superintendent.

Nomads Regents Meet. The National Board of Regents of Nomads at its annual meeting in the California Club, Los Angeles, during the API meeting in that city. Seated, left to right, are: J. C. Basehart, Buda Company, Dallas-Fort Worth; H. M. Cosgrove, executive secretary of the Board, Tulsa; Fred C. Ripley, Jr., International Derrick and Equipment, Los Angeles, secretary-treasurer of the Board. Standing: Edmond L. Lorehn, Cameron Iron Works, Houston, alternate for Ed. M. Fontaine; Brad Mills, American Association of Oilwell Drilling Contractors, Dallas-Fort Worth; Val R. Wittich, Jr., export sales, New York; C. F. (Bud) Vincent, Byron Jackson, Houston, alternate for C. B. McDonald; H. M. Cooley, Bethlehem Steel, Tulsa; A. V. Simonson, New York, export sales, alternate for Russell D. Heath.



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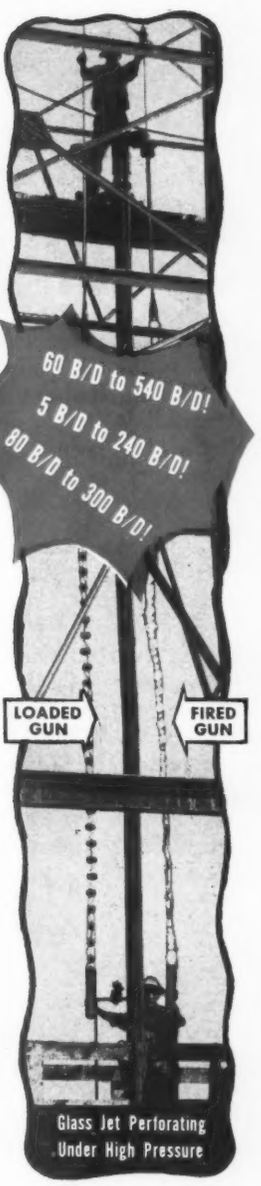
Mean MORE OIL in the tank, even after all other methods fail!



MORE *Oil in the TANK means MONEY in the BANK...*

...and that's what you're after!

When you want cleaner, deeper, straighter holes, even after all other methods had failed to get results, there is only one choice—the new McCullough Glass Jet Perforator. Your reward—MORE OIL in the tank, MORE MONEY in the bank! No carrots or slugs, no splitting or sticking guns, trouble-free jet perforating for the FIRST time!

No matter how you look at it the McCullough Glass Jet Perforator makes sense. The emphasis is on the Glass Jet and not on the carrier. This permits the maximum safe charge of explosives where MORE POWER is needed—in small pipe in deep wells where several casing strings exist. The special heat treated glass units disentegrate completely. The retrievable strip carrier is pulled from the well.

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▸ **Kenneth R. Joynt,** producing division, Magnolia Petroleum Company, has been promoted to assistant district superintendent of Magnolia's Lake Charles, Louisiana, district. He was formerly production foreman in the Falfurrias district. **James G. Sadler** has been promoted from assistant foreman in Magnolia's Falfurrias district to production foreman in the same district.

John T. Jones, Magnolia district land man for the state of Oklahoma, has been transferred from Oklahoma City to Calgary, Canada, to be manager of the land department of the Socony-Vacuum Exploration Company, an affiliated organization of Socony-Vacuum Oil Company, Inc. **Grayson Ray,** district land man at Wichita Falls, Texas, has been transferred to Oklahoma City as district land man for the state of Oklahoma. **Marvin S. Jones** of Magnolia's land department staff in Dallas has been promoted to district land man at Wichita Falls. **William K. Brewster** has been transferred from Magnolia's land department staff at Oklahoma City to the company's general offices in Dallas. **Robert W. Harless** of Magnolia's land department staff, Dallas, has been transferred to Oklahoma City for duties in the company's land department offices there.

▸ **G. M. Andreen,** Magnolia Petroleum Company, petroleum engineer in the Vanderbilt, Texas, district, has been transferred to the Dallas general offices. Andreen is assigned to the proration section in the petroleum engineering department.

Glen W. Barb, petroleum engineer assigned to the Louisiana-Gulf district at Morgan City, Louisiana, was transferred to the Vanderbilt district as a petroleum engineer.

▸ **Alexander W. McCoy III** has been appointed chief exploration geologist of the Tulsa, Oklahoma, division of Gulf Oil Corporation. An Oklahoma University graduate, McCoy joined Deep Rock Oil Company in 1940 after his graduation. He was later geologist for Carter Oil Company, and for the past 5 years has been associated with Phillips Petroleum Company, serving as district geologist in the Rocky Mountain area.

▸ **R. W. McCanne,** assistant to the manager of production, The Ohio Oil Company, at Findlay, Ohio, has been appointed assistant manager of the Casper, Wyoming, division. **E. B. Stewart,** Tulsa, Oklahoma, division superintendent, has been appointed manager of the newly-established Sidney, Nebraska, district. **R. C. Farley,** assistant to the general superintendent of production at Findlay, has been appointed Tulsa division superintendent succeeding Stewart.

McCanne was first employed by Ohio in the Red Desert area of Wyoming during the summer of 1928 while he was a geology student at the University of Colorado. Following his graduation in 1929, he rejoined the company as an assistant geologist. Stewart was a roustabout at Ranger, Texas, when he began with Ohio Oil in 1919. Later foreman at Desdemona and Eliasville, Texas, he advanced to district foreman of Desdemona and Ranger. He was appointed Tulsa division superintendent in 1948. Farley joined Ohio Oil's pipe line department at Del Rio, Texas, in 1926, and was transferred to East Texas in 1931. He was in charge of the company's offshore operations in the Gulf of Mexico from 1948 until his appointment as assistant to the general superintendent of production in 1949.

At the Copacabana. H. T. Irvine, Anglo-Iranian Oil Company, D. T. O'Connor, export sales representative, one of whose accounts is Drilling and Service, Inc., Dallas, Texas, and R. E. Johnson, Anglo-Iranian, at the Copacabana Club in New York City. Irvine and Johnson were in the States recently looking over modern drilling methods, including diamond coring.

▸ **Eugene Cortinas,** has joined the geological staff at Crown Petroleum Company in Houston, Texas. He is formerly a consultant geologist with Dr. J. Huner, Jr., at Baton Rouge, Louisiana.

▸ **Preston McGrain,** assistant state geologist for Kentucky Geological Survey, was recently transferred from Indianapolis, Indiana to Lexington, Kentucky.

▸ **R. C. Mills, Jr.,** division exploration superintendent for Standard Oil Company of Texas, at Abilene, Texas has been transferred to Midland, Texas office in the same capacity. He succeeds **Gail H. Stoddard.**

▸ **J. K. Adams** of Houston, Texas, has been appointed manager of Texas Eastern Production Corporation's land and lease department. Texas Eastern Production is the exploration and producing subsidiary of Texas Eastern Transmission Corporation. Adams was formerly with the Mills Bennett Production Company of Houston and other Mills Bennett organizations. He engaged in pipe line, production, and land and lease operations for these companies from 1929 to 1950. Adams graduated from Baylor University in 1923.

▸ **Merlin J. Johnson** has been transferred from the Tulsa, Oklahoma, production division to the Pittsburgh, Pennsylvania, general offices as a statistician in the gas supply and disposition branch of the production department, Gulf Oil Corporation. Johnson joined Gulf at the Tonkawa Gasoline Plant, Three Sands, Oklahoma, in 1924. He has worked in the natural gasoline plant at Earlsboro, Oklahoma, and as a plant chemist at the company's Burbank, Oklahoma, operation. He was transferred to the Tulsa production division as clerk in charge of gasoline plant records of the production department in 1933 and has served in that capacity until his new appointment.

▸ **James G. Adkins,** Adkins Drilling Company, Great Bend, Kansas was elected chairman of the Kansas chapter of the American Association of Oilwell Drilling Contractors, succeeding **Charles H. Todd,** Rine Drilling Company, Wichita, at the December meeting of the Kansas chapter held in Great Bend. **J. D. Ferrell,** Ferrell Drilling Company, Great Bend, was elected secretary. **E. L. McCartney,** B & R Drilling Company, Inc., and **William S. Brunson,** Brunson Drilling Company, Inc., both of Wichita, Kansas, were elected vice-chairmen of the Kansas chapter.

THE TURNAROUND

And the Seventh Day

THE ADVICE of an old and successful Midwest Farmer to his successor was, "Every time it rains, Son, look back and see how fer ye've got!"

In no industry within our ken is it so necessary to do just this thing. Faced with more exacting demands than any industry under the sun with the possible exception of the steel industry—not overlooking the aviation industry—the petroleum industry now must look at what has been accomplished within the last few years, and to view also the stupendous demands that are coming faster than they did in World War II. With war operations on our necks, as well as the most extensive requirements from civilian consumers that the world has ever known, let us take a glance at what has been done, at the instruments available for meeting our today's and tomorrow's crises.

Catalytic cracking has emerged from its swaddling clothes, as a lusty "infant" of 2,000,000 bbl per day charge capacity or more, with a catalyst efficiency and a total yield percentage unknown during World War II. At least two "midget" catalytic cracking designs have been developed (UOP and Socony), simplifying unbelieveably the wartime and pre-wartime cat units, with their terrifyingly huge bulk and inefficient complexity. Additionally, at least two catalytic reforming processes have been brought out and put into commercial scale practice (UOP and Socony) to improve further the thermal efficiency of the fuels so produced and the engine-fuel combination so necessary to our economy. One of these processes (UOP) encroached blithely on the domain of the famous pharmaceutical catalyst, expensive platinum, and apparently at this writing has made a reforming catalyst containing, reportedly, 8 per cent of platinum into a paying proposition for the world refiner. The other process has not announced its catalyst as yet, but the announcement may be as startling.

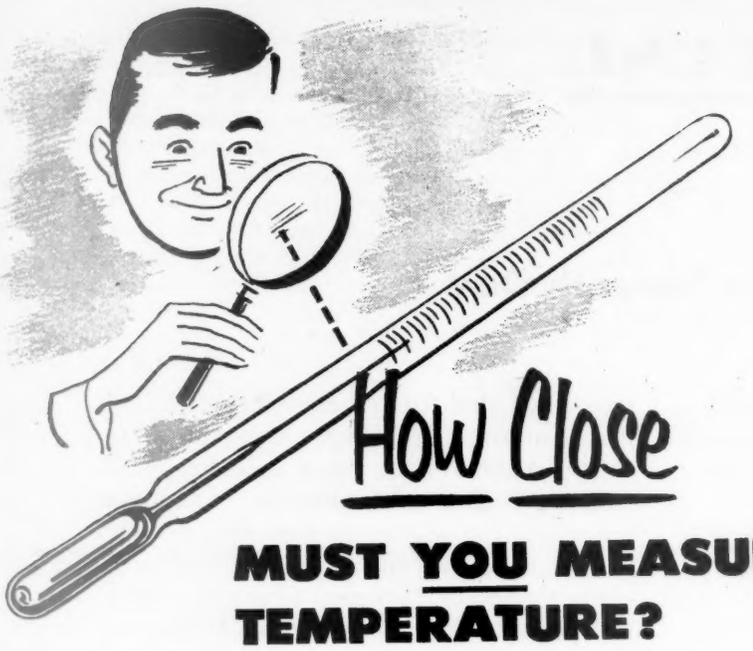
In the face of exacting and often exasperating demands for efficiency, the accomplishments of the American lubricating oil manufacturer are among the most noteworthy matters in the entire industrial field. Oils that oxidize only within five to ten times the amount of service as was the case with earlier oils; oils that keep the engine so clean that wear becomes negligible; additives that maintain foreign and decomposition matter in suspension until eliminated by filters or oil change; oils that carry unit bearing loads unheard of until the last decade; these developments mark a new era in lubrication of ultra-efficient automotive equipment.

Innumerable other items may have one-word mention;

Jet engines require fuel in multitudinous quantities, of specifications unknown heretofore; instead of octane number, of rich-mixture efficiency these fuels require combustibility, maintenance of flame in a blast of air at supersonic speeds, which no power-producing instrument has ever been called upon to do within the history of man. At least 20—probably several more—jet engine fuel laboratories have been built in this country within 5 years, with PRIVATE FUNDS and without Federal subsidy so far as we have been informed, and have solved these problems far ahead of any other nation.

More and more rapidly light LPG-type hydrocarbons are being applied to the fueling of tractors, or trucks, even of buses and private automobiles, to utilize the high efficiency of butane, propane, and LPG mixtures. High efficiency, high miles per gallon, low cents per gallon are some of the advantages in this field, and the market has been barely touched. Carbon black from heavy "waste" residual oils could not be—but it is!

Space will not permit mention of the hundreds of other developments of major importance. Suffice to say that, except for ominous war clouds the oil industry's horizon for 1951 is wider and much more expansive than ever in history. And the industry is for more able to cope with the war clouds than ever before, as is well known.—A.L.F.



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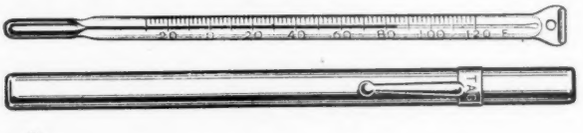
Close? New TAGliabue "Thermicator" pocketype thermometer reads from −30° to +120°F. (spirit-filled); from 0 to +220°F. (mercury-filled). No cap to unscrew—whisk it out of its case for fast readings, or use it in its ported case for protection. Graduated in 2° divisions.



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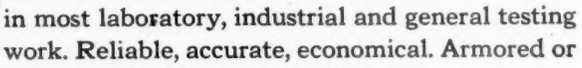

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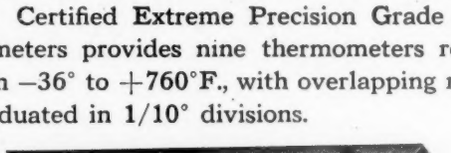

Calorimeter thermometers reading to 1/100°C. are also standard.

All types of laboratory thermometers and hydrometers are detailed in this useful TAG Catalog, No. 1100E. If you ever need to know temperatures, send for your copy today!

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TAGliabue Pressure Recorder Charts Up To 7,500 P.S.I.

Catalog No. 1210 Recording Pressure Gages, available from TAGliabue Instruments Div., Dept. 67, Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J. combine simple design with accurate calibration. They provide permanent records of vacuum or pressure on either 10-inch or 12-inch circular charts.

Interchangeable tube systems of these TAG instruments are laboratory calibrated at the factory. Safety links provide over-range protection. These recorders are supplied in various ranges between the limits of 30 in. vacuum and 7,500 lb. per sq. in. pressure.

"TAG" Certified Hydrometers Promote Precise Readings

Easily read scales and refinements to enhance accuracy are features of the Certified Hydrometers available from TAGliabue Instruments Div., Dept. 67, Weston Electrical Instrument Corp., Newark 5, N. J. Made in both the plain and combined type (with integral thermometer), they have double gravity scales which can be read from any position. Open graduations on long metal thermometer scales enable user to tell temperatures within ¼°F. Large bore lens-front thermometer tube with red stripe above mercury makes reading easier. Weight is solid metal ballast. Streamlined tips are easy to clean and allow the instruments to settle quickly in viscous fluids. Accuracy is guaranteed to exceed A.S.T.M. and U. S. Bureau of Standards requirements, and is attested by individual accuracy certificates.

"TAG" Temperature Recorders Chart from −300° to +1000°F.

Accurate written records of varying temperatures are charted by the Temperature Recorders produced by TAGliabue Instruments Div., Dept. 67, Weston Electrical Instrument Corp., Newark 5, N. J. Temperatures as low as −300°F. or as high as +1000°F. can be recorded with these versatile instruments.

Various types of actuations in TAG Temperature Recorders achieve scale expansion for utmost precision over the working ranges. Interchangeable tube systems are laboratory calibrated at the factory. A safety link provides over-range protection. Details are given in Catalog 1210.

Lubrication of Refinery Equipment

Specifications for lubricants and their choice for steam turbines, steam engines, and internal combustion engines.

C. M. LARSON

In 2 Parts—Part 1

ONLY recently the petroleum refinery departments have been alerted to the same lubricating engineering service as that offered by the sales technical service department to industrial plants. A check of various companies shows that in some cases, the lubricant selection and the schedules of lubricant feeds are a matter of indifference left to an oiler, whereas in others, a lubrication engineer, assigned to the refinery department, or one scheduled at regular intervals by the technical sales department, handles such necessary lubrication responsibilities.

There is nothing more embarrassing to the sales department, than to have the equipment manufacturer find, that after erecting a machine, a numbered stock oil is used instead of the trade name lubricant, which the staff engineer of the technical sales department has taken years to build up sufficient confidence in, in order that the piece of equipment can carry an approval plate of the trade branded oil specified exclusively for the machine. Surely, if the technical sales department can show such savings in maintenance and lubricating costs for other industries, why not for the petroleum industry, and especially for the refinery department?

One of the large oil companies advise that at each of their refineries they have men assigned to lubrication. At their larger refineries they have a lubrication engineer under the manager of the power department. At the smaller refineries, the power engineer also fulfills the duties of the lubrication engineer. In their case, all equipment in their refineries is lubricated in accordance with the instructions or recommendations of the manufacturer of the equipment insofar as it is practical to follow these instructions. If the manufacturer has a name plate that states that he approves the use of a competitive product, they would of course, apply products of their own manufacture. At each refinery all equipment is lubricated according to issued instructions as to grade, frequency and amount, and also the lubricants used must come from the storehouse stocks of packaged products. In this way, they keep good records of not only costs of lubrication but of the effectiveness of the lubricants used.

The Author

C. M. (Cliff) Larson joined Sinclair Refining Company, his present affiliation, upon release from the Army in 1919. He has advanced from assistant supervising engineer to chief consulting engineer. Along with being chief consulting engineer, he also acts as chairman of Sinclair products committee. Upon his graduation from Armour Institute of Technology, he joined The Texas Company, going into the army at the outbreak of World War I. He is the inventor of the Visgage, a pocket Saybolt viscosity measuring instrument, and Dilut-O-Meter for checking dilution in motor oils and other viscosity indicating instruments. Larson served as expert consultant to Secretary of War covering fuels and lubricants problems, during World War II.

Other companies reported they do not have a special lubrication engineer assigned to their refinery department, but in a few cases their chief lubrication engineer of the industrial sales department serves as lubrication engineer for the refinery division when necessary. He makes complete surveys of all refinery equipment and specifies lubricants for use by their refineries, and serves in a consulting capacity for the refinery department on all lubrication problems. This also holds true for the production division of oil companies.

The next two articles will cover the various lubrication problems of refinery equipment employed in the boiler and power house, stills, pump houses, contact, acid and solvent units, barrel house, and grease house.

EXCLUSIVE

The selection of lubricants in the operating departments of refineries as in any mechanized industry, involves a consideration of the requirements of the equipment together with the available methods for handling and application of the lubricant itself.

It is not necessary for operators to parallel the highly specialized work done in either control or research laboratory departments in order to choose the proper lubricant for a particular application. As a corollary, it is unnecessary for the operator to work up specifications with the intent of having special products blended.

Most manufacturers of equipment have carried on considerable test work and have determined which SAE viscosity of the correct grade of oil performs to the best advantage in their machinery. In many cases the conditions of service, class of power drive, method of driving, materials being handled or processed, the end use of the products or processes and many other circumstances, some unique, influence the particular choice of lubricant used. Some manufacturers of machinery have published general specifications, others refer to oil by SAE viscosity grades, some recommend oil by viscosity at either 100, 130, or 210 degrees F. Still others recommend oils and greases by brand names.

Specifications for Lubricants

Specifications imply narrow limits, and experience of many years has shown that no exact specifications of universal applicability may be drawn safely for lubricating oils.

This means that a characteristic, costly to acquire, may perform well in a given location under certain conditions, but the same quality would be unnecessary and perhaps objectionable under other circumstances.

Special refinement or blending increases the price per gallon and, unless provision is made to conserve the oil and reduce wastage, it is clear that it would be unnecessarily expensive to use these high priced oils when general purpose, lower priced products, would serve as well. On the other hand, if the greater portion of the

Full pressure lubricated turbine and hot oil pump. Corrosion resistant turbine oil 6 in chart.* Bearings are all water cooled. *Courtesy, Elliott Company*

equipment required premium grade lubricants, and in comparison, the general purpose oil requirements were few, it would be folly to consider providing two grades of oil. The reasoning in this case is that very little actual saving could be effected by providing two grades of lubricant. The proper procedure would be to select the higher grade product and use it for all machines. A premium oil will work well on lower grade equipment and, although somewhat more good oil may be used than theoretically necessary, a certain insurance against damage to the precision equipment is had because there will be no possibility of using a lower grade oil where the better product is required.

Irrespective of the application, there are certain inherently desirable qualities of a good lubricating oil. These are generally accepted by the oil industry. A good lubricant should be a petroleum derivative, free from water, sediment, acids, soap, resins, or any materials that experience has indicated will prove injurious to the life of the oil, or to the equipment with which it is intended to be used.

Other more specific properties could be given as desirable but the requirements vary in different applications and the characteristics of the lubricants differ independently, depending upon the crude oil as well as the refining processes used.

No matter how careful the designer is to insure adequate lubrication of his equipment, or the oil refiner to provide good clean oils having the proper characteristics for the service, final dependence must be placed upon the operators to be ever diligent in observing oil temperatures, adequate flow to bearing surfaces, ample reserve quantities and other necessary details. Care must be used while filtering the oil for further use and good housekeeping must be exerted to insure internal cleanliness of the entire system. If coolers and strainers are used, they should be kept clean.

The use of additive type lubricating oils to improve and intensify certain characteristics of the base oil, for specific applications or to widen their field of usefulness, places modern lubricants in a class by themselves and analysis by conventional methods often result in misleading values.

It should be understood thoroughly that the recommended values given in specifications apply to new oil only.

Once lubricating oil has been placed in a machine and used, whether in individual ring oiled bearings or an extensive circulating system, certain of the values are reduced while others are intensified. The reason for this is the fact that the oil picks up contaminating bodies during its journey through the system. Air, moisture, dust, pipe scale, gum and oxidized oil from previous operations, and in internal combustion engines, raw and partly burned fuels.

Another point worth mentioning is that specifications for lubricating oils compiled by manufacturers of machinery have been calculated for clean, new equipment, in good working order. When the parts become worn and clearances increase, the machines or circulating pipe lines acquire accumulations of sludge-like filth. Air-cleaners and vents become fouled or plugged with dirt and moisture or other materials enter the system to circulate along with the oil, then operating conditions can change so that an oil meeting the original specifications becomes unsuitable for use.

Steam Turbines

Steam turbines are prime movers. They are never operated alone but always used to drive other equipment. High speed turbines are more economical to build and operate.

Regardless of the size of the unit, whether low horsepower or ponderous cross-compound units of several thousand horsepower capacity, each is highly precision built. All rubbing surfaces are finely finished to very close tolerance so that clearances, while uniform, are very small. Speeds are high so that a lubricating oil of comparatively low viscosity is indicated.

The use of steam turbines in refinery operation differs considerably from usual practice, particularly in their method of handling steam. These turbines exhaust at comparatively high pressures into service lines for smaller turbines, steam pumps, and other processes.

Any electric power generated by the turbines is actually a by-product and relatively cheap because the fuel charge is not against the power turbine. Steam at high boiler pressure (600 to 900 psi) is passed through this engine and exhausted at from 125 to 250 psi into the line serving smaller turbines that drive pumps or compressors. These smaller turbines, in turn, exhaust at from 20 to 25 psi and this steam is used for processing, heating, or is returned to surface condensers in order to recover the condensate for boiler feed water.

In effect, the steam turbine used in the modern refinery is actually a glorified reducing value for steam and any power generated is usually incidental.

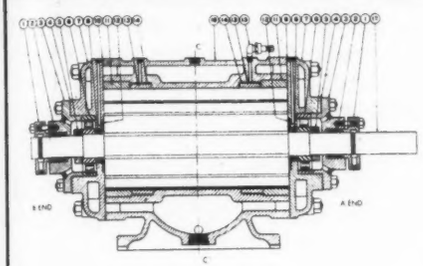
The lubrication of these steam turbines is really confined to journal bearings because the direct-connection to generators and centrifugal pumps does not require the use of reduction gears.

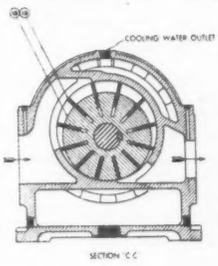
The larger units are provided with a circulating oil system of the gravity or pump circulation type. If a gravity system is employed, more than one unit may be serviced, if they are conveniently placed. Some units are self contained to the extent that an oil sump, of ample capacity, is located in the base of the machine. The oil pump is driven by the main shaft circulating the oil throughout the system, including governor and cooler.

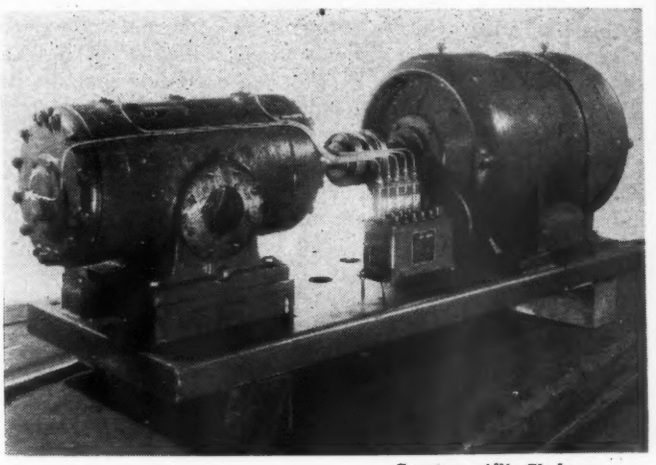
The smaller turbines, direct-connected to centrifugal pumps or blowers are provided with ring oiled bearings.

The performance level required of steam turbine lubricants is very high,

*Chart will run in Part 2.







1—Stuffing Box Gland
2—Stuffing Box Packing
3—Stuffing Box
4—Gasket
5—Bearing Lock Collar
6—Load Bearing
7—Cylinder Head
8—Spacing Ring
9—Gasket (A-End)
10—Gasket (B-End)
11—Retaining Ring
12—Wearing Plates
13—Floating Ring
14—Floating Ring Blades
15—Angle Check Valve
16—Cylinder
17—Rotor Shaft
18—Rotor
19—Rotor Blades

Courtesy, Allis-Chalmers

Rotary gas compressor driven by explosion-proof electric motor. Compressor is supplied lubrication from independent mechanical lubricator. See lubricant 1 for the compressor and motor bearings.

and there should be no appreciable deterioration of oil quality during its long service life.

The viscosity characteristic of a turbine oil is of basic importance. If the viscosity is too low the oil film may not be able to support the weight of the rotor without rupture. On the other hand, when the viscosity is too high, the oil cannot follow through properly at the high journal speeds to enter the very small clearance spaces between the revolving journal and bearing. In this way the bearings are actually starved for lubrication, dry spots develop and the bearings overheat because of the excessive friction and less dissipation of heat because of lower circulation rate.

In this connection, steam turbine lubricating oil is depended upon to carry away the heat developed in the bearings.

All organic matter oxidizes more or less in the presence of air and heat. As petroleum oils are of organic nature they are also subject to this process. For this reason oxidation inhibitors are added to the turbine oil in order to reduce and control this condition. Sludge in turbine oil is also an oxidation product aggravated by fine particles of metal and other sludge-forming materials which circulate with the oil within the system.

Actually, this is a condition of poor housekeeping and is more a question of preventive maintenance than of oil quality. When good maintenance is observed, the turbine oil carefully clarified and the system kept free from accumulations of these sludge-forming bodies, a modern steam turbine oil should render years of service.

Water often causes considerable trouble in the larger steam turbines that employ circulating oil systems. It may enter through leaky gland seals, gaskets, oil cooler tubes, or by condensation from the atmosphere.

Water alone does not injure clean oil but, if present in sufficient quantities, it can be injurious to the turbine itself. Even small quantities of water carried by the oil may cause corrosion of the journals, governor or other highly-finished surfaces.

The lubricant of the smaller sized turbines is carried in an oil well provided within the bearing and is circulated by means of an oil ring, which dips into the oil. This ring is revolved by the journal upon which it rests. Although these bearings are provided with dust-tight covers closing the inspection openings, there is a possibility of dirt or moisture entering the oil and frequent inspection is required.

Turbine oil is normally resistant to emulsion, but when the surface tension of the oil is reduced by the presence of oxidation products, emulsions may be formed. Proper clarification will rid the oil of moisture and other contaminating materials that tend to cause emulsions.

Corrosion inhibitors are incorporated in modern turbine oils. The oil is expected to cover and wet the entire inner surfaces of tanks, sump and oil pipe lines for protection against rust. Most of the troublesome corrosion, sometimes found upon the inner surfaces of turbine installations, is caused by the entrained moisture. Proper venting of the oil sump, reservoirs, gravity, and reserve tanks helps to reduce the moisture content, if any, in the oil. In this connection, care should be used not to paint the screen provided to keep insects or dirt from entering the vents.

When lubricating oil foams it exposes large areas on both sides of the very thin films to the action of the air. This condition helps promote rapid oxidation of the oil. If foam enters the loaded area of bearings under the journal it is not able to carry the load, rubbing and bearing failure may result. Any foam in the oil pump suction line will cause an air-lock at the pump so that the pump cannot lift the oil and the oil pressure fails in the entire system. Modern steam turbine oils are inhibited against foaming.

The surface speed of steam turbine journals is comparatively high and because the lubricating oil is charged with the dual task of reducing bearing friction and carrying away any frictional heat developed, a comparatively low viscosity is indicated when a circulating system is used.

A turbine oil of 150 to 350 viscosity at 100 F would be indicated for circulating and force feed systems. When steam turbines are provided with ring oiled bearings only, a somewhat heavier oil is required because in this design, the heat picked up by the lubricant from the bearing must be dispersed to the surrounding air from the outside surface of the bearing housing. Allowance must be made for a higher temperature of the oil that reduces its vicosity at operating temperature.

Under these circumstances, an oil having a viscosity between 325 F and 600 F would be chosen, the higher range in viscosity being selected where the ambient temperature is higher.

Steam turbine lubricants are selected from oils known to have highly stable properties.

Additives are incorporated in or-

der to reduce foaming and to protect the fine finish of the machine from possible bad effects due to condensation or moisture that the oil may pick up as it circulates.

Typical oil characteristics compiled by steam turbine manufacturers are given below:

Part of DeLaval Steam Turbine Company's recommendations, which apply to turbines installed in oil refineries, are as follows:

	Single stage units		Multi-stage units	
	Direct drive Water cooled	Ring oiled No water cooling	Forced feed	Geared units
Flash point	350 F	350 F	350 F	350 F
Viscosity at 100 F	250/375	375/600	140/250	250/375
Viscosity at 210 F	47	53	...	47
Rust resistance test	Must pass	Must pass	Must pass	Must pass
Maximum viscosity for starting	700 SUV	700 SUV	700 SUV	700 SUV

Part of General Electric Company's characteristics, which would apply to turbine installations in oil refineries are as follows:

	Forced feed		Ring oiled Land geared
	Land and marine Direct-connected	Land geared Auxiliary sets	Auxiliary geared Direct-connected
Viscosity at 100 F	140/170* SUV	270/325* SUV	270/325* SUV
Viscosity at 210 F	43	49	49
Flash point, min.	330 F	350 F	350 F
Neutralization No.	0.13 Max.	0.13 Max.	0.13 Max.
ASTM steam emulsion	120 Max.	150 Max.	150 Max.
Viscosity before start	800 Max.	800 Max.	800 Max.
Corrosion resistance test	Shall pass	Shall pass	Shall pass
Oxidation test, hours	1000	1000	1000

Part of Westinghouse Electric and Manufacturing Company's properties, which would apply to turbine installations in oil refineries, are as follows:

	Direct connected turbine units	Single reduction gears
Flash point, min.	330 F	350 F
Viscosity at 100 F	140/250	250/350
Viscosity at 100 F	140/250	250/350
Viscosity at 210 F	40/50	47/60
Carbon residue	0.10 Max.	1.0 Max.
Neutralization number	0.10 Max.	0.10 Max.
Corrosion resistance test	Shall pass	Shall pass
For turbines provided with ring oiled bearings:	Ambient temperature	
	180 F	Above 180 F
Viscosity at 100 F	400/500	600/800 sec. SUV

Steam Engines

In refinery practice, reciprocating type steam engines are being replaced by more efficient, or more convenient equipment such as electric motors, and steam turbines.

Before recommendations of lubricants can be made, all conditions of service should be known and considered, such as:

Type of engine, speed, load, steam pressure, steam temperature, steam quality, and the use made of the exhaust steam.

Steam engine lubrication is actually divided into two distinct parts: That of the steam cylinder and valve, and the external parts that include bearings, slides, and linkage. Entirely separate and different oils are used for internal and external lubrication. The pistons, valves, and piston rods, including metallic packing; are considered internal and the lubricant used is exposed to and in intimate contact with the steam and at elevated temperature. The external parts are not subject to high temperatures so the oil may be of lower viscosity.

In greater detail, the engine design may be open frame or closed crankcase; cylinders arranged vertically or horizontal, or both; simple or compound. Steam distribution may be had using a plain D slide valve, riding cut-off with D valve, piston valve or poppet valves as in the Uniflow type engine.

The speed depends somewhat upon the class of service, direct-connected to electric generator, centrifugal pumps, or flywheel type air compressors.

Load may be constant, fluctuating, light or heavy. The temperature of operation and bearing pressures are influenced by the loading conditions.

Steam temperature varies with the pressure but in general refinery practice reciprocating engines seldom are called upon to operate with seam pressures in excess of 125 to 150 lb gage pressure.

The quality of the steam is important because it is a measure of the amount of moisture present in the steam. Moisture, or water, has a washing action that tends to sweep petroleum oil from the hot rubbing surfaces of the cylinders and valve seats. In fact the spaces between piston and cylinder or steam valve and its seat are very thin, or capillary in nature, so that the greater surface tension of the water draws it into these spaces forcing plain petroleum oil out. (The ratio of surface tension is roughly water 3: petroleum oil 1.)

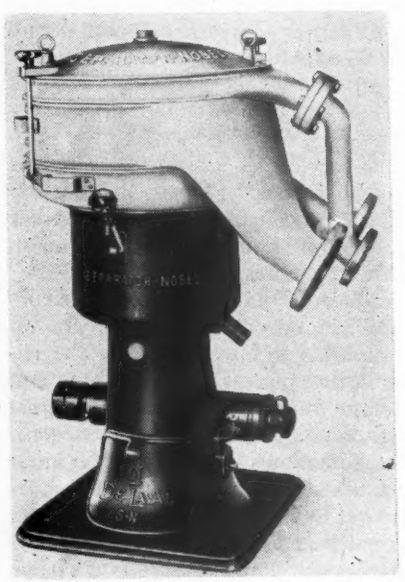
The use made of the exhaust steam must be fully considered before final recommendation for the steam cylinder oil can be made.

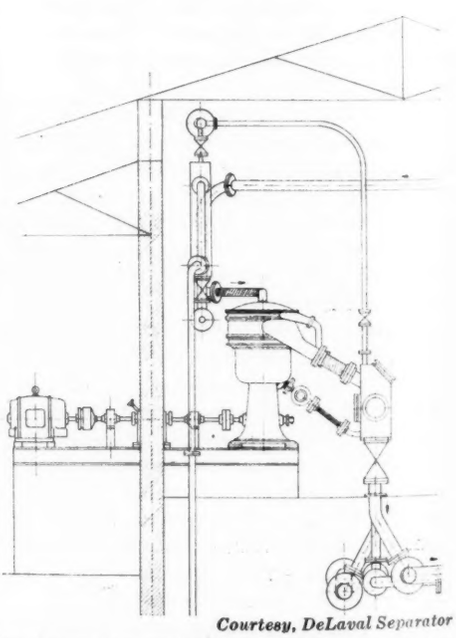
We will determine the steam cylinder oil first.

Slide valves require more lubrication than piston valves and horizontal more than vertical. Poppet type valves require oil for the stems only.

Vertical cylinders require less oil than do horizontal. Engine speed will have little bearing on the cylinder oil recommended because any reciprocating engines in the refinery service would be the so-called high-speed class and rubbing speeds would be closely comparable. Loading also has more effect on external lubrication. Steam pressures are moderate but the quality in the field would be very wet so that a compounded type oil is indicated. The compound would be acidless tallow oil which will emulsify with any free moisture present to insure keeping the oil in place upon the rubbing surfaces.

The final consideration is the use to which the exhaust steam is put. Usually such exhaust steam is used for certain processing such as in closed coil heaters, absorption type refrigeration plants, in shell stills running to coke and sometimes in the bottoms of tube stills running to cylinder stock. All of such exhaust must be passed through oil separators before the





Courtesy, DeLaval Separator

Centrifugal type separators are used for dewaxing and other clarifying purposes and they are essentially high speed machines. They require a highly refined, non-additive, turbine type lubricant. See No. 1 in chart.

steam is available. It cannot be used where oil-free steam is required.

For this service then a steam refined cylinder stock of 130 to 150 seconds at 210 F plus 5 to 7 per cent acidless tallow may be used.

In this connection, the wetter the steam the greater should be the amount of compound present. We do not depend upon the oil to carry away heat and it is used sparingly.

The conditions surrounding external lubrication requirements are; type of engine frame, whether open or closed crankcase, speed in rpm, loading conditions and method of feeding.

The open type frame, speed of about 250 rpm, average load conditions, and feeding from oil cups using an "all-lost" system would require a medium viscosity oil (about 300 seconds at 100 F) in the low-price brackets. This is because very little saving can be made in oil.

The other extreme would be a tight crankcase having splash or pressure feed. Here we require a well refined product of medium viscosity, which will separate quickly from water and allow other contamination to settle out. This oil must not evaporate excessively at crankcase temperature.

Although such an oil is a little more expensive in cost per gallon, it will last a long time and prove far cheaper in the end. In this connection, the lower priced oil cannot be used in the engine crankcase at all because it is not suitable for this purpose.

Internal Combustion Engines

Internal combustion engines may be grouped according to the fuel used such as gasoline, diesel, or natural gas.

Experience has shown that the fuel used has considerable influence upon the selection of lubricants although many of the characteristics of these engines may be similar.

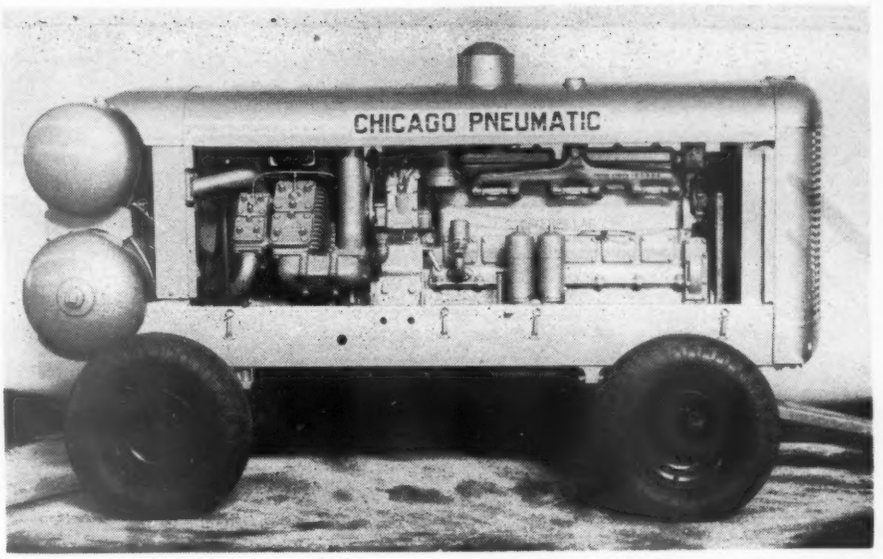
Gasoline Engines

Starting with gasoline engines, consider first what service conditions have to be met.

The oil placed in the engine is expected to lubricate but unfortunately, this actually means more than one thing; it must reduce friction, cool the moving parts, seal the piston against blow-by, or leakage, and keep the internal parts of the engine clean, or actually devour the refuse which finds its way into the engine.

This means that in order to reduce friction the oil must remain slippery but, during normal service, the engine makes the oil dirty or gritty.

In order to lubricate the oil must be thin, so it will spread rapidly, and work into the extremely thin clearance spaces, but in order to seal the piston against loss of power, the oil should stay thick or viscous. The oil should also be thin so it will carry heat away rapidly.



Courtesy, Chicago Pneumatic Tool Company

Diesel-driven portable air compressor requires heavy duty motor oil SAE-30 Grade for engine and compressor crankcases.

In order to lubricate and keep the moving parts slippery, the oil must stay clean, but in order to scavenge the engine it must collect and hold dirt and grit.

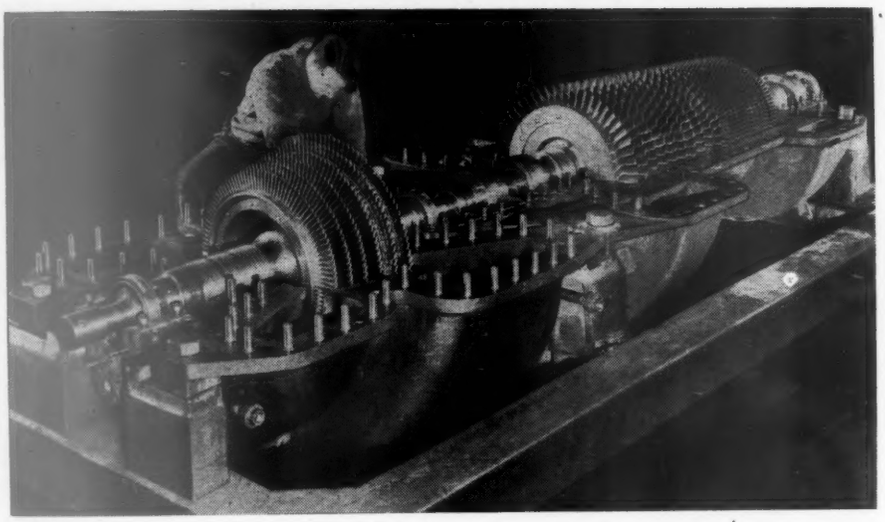
The gasoline motor is continuously causing its own destruction by adding contaminants to its life blood. The intake air breathes some dust or dirt into the oil. Carbon from partly burned fuel enters from the combustion chamber. Water enters the lubricating oil from the products of combustion. Some raw, unburned, or partly burned fuel is added to the oil during acceleration, cold starts or when the choke is operated. At the same time, metal particles, worn from bearings, rings or cylinders, are also picked up by the oil.

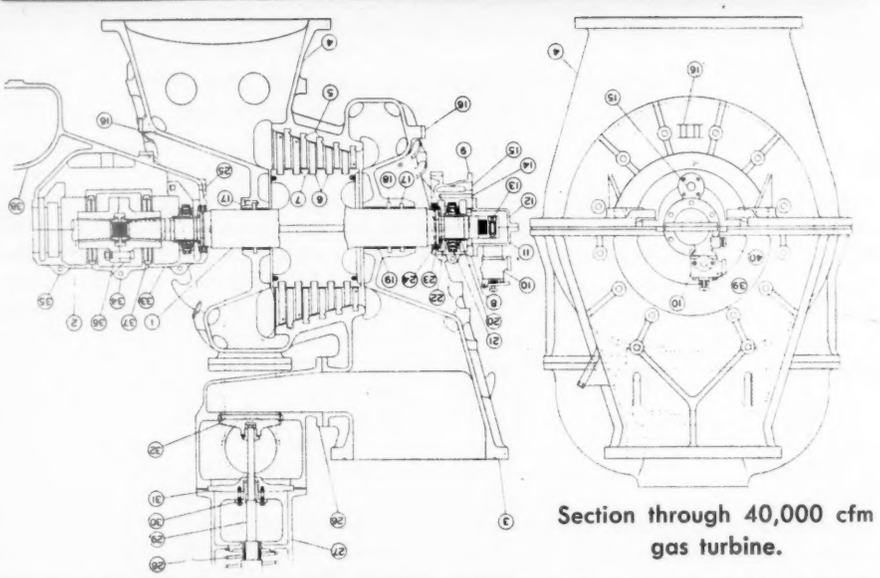
Not every gasoline engine operates under ideal conditions, and even normal service means short runs with many starts and stops. Such service conditions impose a more severe burden on the engine and engine oil than most long runs or continuous driving. During these short runs the engine takes in a fuel-rich mixture, the cylinders and lubricating oil are at comparatively low temperatures and the crankcase receives poor ventilation. All of these conditions accelerate contamination of the crankcase oil with partially burned fuel, water, soot, and dust, the ingredients of common mayonnaise-like cold sludge.

Air filters remove only a part of abrasive dust (silica) from the huge volume of air drawn into the cylinders and crankcase. Occasional long trips or hot runs tend to harden, or bake, cold, sticky, sludge into a hard mass. Sludge clogs oil screens and oil lines, and plugs oil control rings. Sticking valves and piston rings, oil starvation of parts to be lubricated, possibility of corrosion of bearings and high oil consumption can be reduced to a minimum by proper oil changes.

The water mentioned is produced by combustion of the fuel. It has been established that for every gallon of gasoline used by the engine, a little more than a gallon of water is produced. Most of this water, in the form of superheated steam, is expelled through the exhaust but a portion finds its way into the crankcase and is condensed by the comparatively cool walls of the case. Most of this trapped moisture becomes mixed with lubricating oil.

Carbon is one of the by-products of incomplete combustion. Both gasoline and the motor oil are hydrocarbons and if either were completely burned they would be exhausted as colorless gases. In the engine the fuel (gasoline) is intimitely mixed with air as it enters the cylinders during the suction stroke. Some circumstance, insufficient air, too late ignition, cold cylinder walls, or other condition, permits some of the carbon portion to remain unconsumed or the heavier portions of the fuel to be partially burned when the lowered temperature, within the combustion chamber, brings combustion to a sudden stop. The free carbon is in the form of a very fine, black powder, which is immediately absorbed by the oil film, adhering to the cylinder walls, with which it now comes in con-





Section through 40,000 cfm gas turbine.

Gas turbine lubricated by means of circulating system using highly refined, additive, turbine type oil. See lubricant No. 6 in chart.

Courtesy, Allis Chalmers

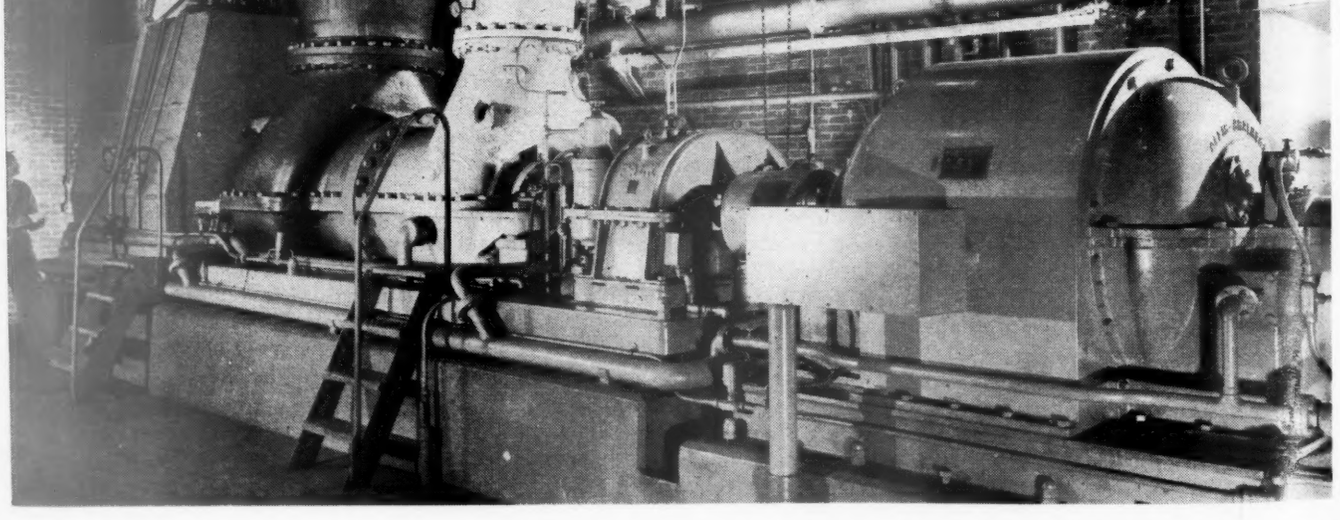
tact. The partly burned portions of the fuel also become engulfed.

The dry carbon is a mild abrasive and held in place by the thin oil film, tends to wear both cylinders and rings. The unburned portions of fuel are sludge forming bodies and in conjunction with moisture and fine metal particles, rubbed from rings and cylinders, all mixed together in the lubricating oil, agitated in the presence of air, and cooked by the heat, certain chemical actions take place which produce additional filth such as polymerized bodies, resins, emulsification products, and "gunk".

To complete the picture, when some of the liquid fuel remains unburned after combustion, or enters the cylinders during excessive choking, it finds its way into the lubricating oil. This dilution thins the oil below safe values for proper sealing because a small quantity of fuel causes a relatively large decrease in the viscosity of the lubricating oil.

Filters will not remove dilution, dissolved gums, or organic acids, which are natural products of combustion. They will remove granular particles and certain gummy substances but the element becomes fouled as the material accumulates on its surface. Good maintenance demands frequent changing of the filter elements.

Another unheralded contaminant of gasoline engine lubricants is antifreeze radiator solutions. Even very small quantities of this material will ruin the oil as a lubricant in a very short time. As little as one-half of one per cent in the oil can thoroughly



wreck an engine in a few hours time because of its peculiar action on the oil itself.

By this time, the reader begins to sense the advisability of changing the oil in the engine crankcase frequently in order to give it a little help in its task of lubrication.

Petroleum refiners have known for years that the ability of an oil as a cure-all has definite limits. It will not replace metal and, cannot be used as a substitute for good maintenance. As a result of many years research, the average drain period for normal service conditions was fixed at 1000 miles for automotive engine and 35 hr for stationary jobs.

Fleet operators may extend, or contract, this mileage period when careful preventive maintenance methods are followed. So also will careful operators of stationary equipment be in a position to vary drain periods after studying and weighing all of the conditions of service.

Since the viscosity of lubricating oils influences their application, the user needs help in classifying the various grades in terms of viscosity. The general designations of light, medium, and heavy are not definite enough because they vary with different manufacturers, therefore, SAE viscosity numbers are designated.

The mechanical condition of the engine and the manner in which it is operated have the greatest effect upon the rate of deterioration of the oil itself. As changes occur in the oil they react upon both the engine and the oil. Intelligent preventive maintenance and proper operation must be observed in order to control contamination, as much as possible.

The consumption of oil varies somewhat in different engines, and an engine in the best possible mechanical condition will consume some oil.

The answer to the question, what kind of oil should be used, is to use a "balanced oil." This means an oil having qualities that enable it to give equal performance in reducing friction, sealing the pistons against loss of power, cooling the parts being lubricated, and keeping the engine clean.

Engine operation subjects oil to the deteriorating effects of high temperatures. It contaminates the oil with dust, drawn in with the air, carbon from the fuel, water from products of combustion, metal particles worn from bearings and cylinders, and heavy ends of fuel from choking or too rich mixture.

The engine may be abused by overspeeding, overloading or being allowed to overheat.

The right SAE grade to choose is the lightest grade the mechanical condition of the engine will allow. A light grade oil absorbs heat faster and disperses it faster than a heavier grade oil. In this connection, oil has only about half the heat capacity of water. It absorbs and releases heat at about one-half the speed of water.

A light oil can penetrate into close clearance spaces much faster, and its own internal friction is less than that of a heavier oil. It spreads faster so the moving parts are protected quickly after starting up and it will maintain a good oil film at high speeds when bearings would be starved were a heavier oil used.

A heavier bodied oil would seem desirable to seal the pistons properly and if the viscosity of the oil is not sufficient, at the temperature of operation, too much oil will be used. If the cylinders, pistons, and rings are worn so badly that a heavier grade oil is actually necessary for sealing than can be safely used for the bearings, however, then it is high time the engine be overhauled and placed in better mechanical condition.

All of this indicates that the proper grade of oil is the lightest oil that can be used without excessive consumption or wear.

Just a word regarding the specifications for oil.

The physical properties of motor oil have a definite value in determining characteristics but the importance of these properties should not be overestimated. Physical specifications alone do not classify the lubrication value of an oil in modern engines. They are laboratory standards only, and are useless for determining the performance in an engine. They aid in controlling refining processes and are practically valueless when applied to used oils.

The most important physical properties of motor oils are: Gravity, flash and fire, viscosity, color, pour point, viscosity index, carbon residue, sulfur content, neutralization number, and saponification number.

Gravity is the ratio of the weight of oil to that of the same volume of water.

Flash and fire were originally used as safety tests and are of interest now as insurance against fire hazards when oil is stored.

Viscosity is used as a standard in measuring the body, or grade, of an oil. Viscosity changes inversely with the temperature.

The color of an oil has nothing to do with its lubricating ability. It may be artificially duplicated and additives may change its intensity.

Pour point is not an accurate measure of the startability of an engine in cold weather but it indicates the lowest temperature at which an oil will flow from a container without assistance.

Viscosity index indicates the rate of change in viscosity as the temperature of the oil rises. The higher the viscosity index, the less change in viscosity with equal increments of temperature.

Carbon residue is a measure of the amount of carbon formed under controlled laboratory conditions but it does not indicate the amount of carbon that may be deposited in an engine by the same oil.

Sulfur, neutralization, and saponification numbers are of use to the petroleum chemist in controlling the operations of the refinery runs.

A large majority of motor oils now used are of the Premium Type, which means they are fortified with additives and detergents in order to meet the demands of modern engines. It is no longer possible to make a complete evaluation or an intelligent comparison of oils simply by referring to the physical tests. The performance of one oil versus another may be attributable to differences in additives. It is not possible to classify one additive type oil as better than another except through expensive, time-consuming, full-scale engine tests under controlled conditions.

Finally, it is not the kind or amount of additives in the oil that counts, it is what they will help the motor oil to accomplish.

Diesel Engine Lubrication

What has been said for gasoline engines, holds also for diesel engines, with the exception that the diesel fuel is more critical than is gasoline.

Diesel fuel is less volatile than gasoline, and there is a tendency toward higher sulfur content. When the higher sulfur fuels (above 0.5 per cent) are used, special additives and greater proportions of them are necessary.

Diesel engines should not be idled over long periods, and should normally run at temperatures higher than is necessary for gasoline engines.

The fuel in natural gas engines is dry and there is far less trouble experienced in contamination of the lubricating oil by unburned portions of the fuel. The exhaust gases are generally at higher temperatures that tend toward a drying out effect.

The cylinders of natural gas engines are generally supplied with oil from an independent lubricator and the oil recommended for the cylinders is usually one grade heavier than for the bearings.

While lubricating oil is expected to give years of reliable service in steam

turbines, at the other extreme, diesel engine lubricating oil must be changed frequently, sometimes in less than 50 hours operation.

The outstanding difference in the performance of diesel engines versus steam turbines is the vast quantity of contaminating materials, which diesel engine lubricating oils collect in service.

While steam turbine oils may be readily described by enumerating their physical properties, with proper tolerance allowances, this system is not suitable for internal combustion engine lubricating oils. The advent of solid injection, high horsepower output, and smaller high speed engines have made it necessary to revise previous concepts on establishing criteria by which an oil's performance in an engine might be evaluated. These developments have proved clearly that the only way in which performance factors can be established is through the actual engine performance tests. Present day acceptability of diesel oil performance is based on passing satisfactorily the minimum requirements of accepted engine test procedures such as heavy duty type Army Specification 2-104B, MIL-2104, Navy Specfication 14-0-13a (9000 Series) and approval tests established by individual manufacturers including Caterpillar, General Motors, American Locomotive, etc.

As a major part of Specification 2-104B, or the newer MIL 2104, engine performance tests are carried on in conformity with the CRC designation L-4-545, "Test Procedure for Determining Oxidation Characteristics of Heavy-Duty Crankcase Oils."

In this procedure, a crankcase lubricant is evaluated only in respect to stability or resistance to oxidation, bearing corrosion, and the deposition of intrinsic contaminants resulting from decomposition, oxidation, or other changes that occur in the lubricant in service.

The two major sources include products of combustion from the combustion zone, depending upon design, mechanical condition, and specific conditions under which the engine is operated; secondly, sources inherent in the lubricating system and in the oil itself. They result from changes in the oil and depend upon the type and quality of the oil as well as operating conditions.

The procedure involves the intermittent operation of a special six cylinder automotive type test engine at constant speed and load for a total of 36 hr, subsequent to a run-in period of a 8 hr. Prior to each test all engine parts are cleaned and are also reconditioned thoroughly after each test. A complete set of new piston rings is installed and two new, weighed, copper-lead test bearings are installed in symmetrical locations.

Performance of the test is judged by examination of the power section for deposits by ascertaining the weight loss of the test bearings, and by inspection of the new oil and the samples of used oil taken near the middle and at the end of the test.

Two reference oils are employed for standardization of engine operation. One being an oil of high rating, and the other an oil of low rating.

The fuel used throughout the test, including the standardization periods, must conform to Type A, U. S. Army Specification 2-103B, Amendment I, and to certain restrictive requirements. All fuel used for any series of tests must be from the same source of supply.

Engine speed, load, spark advance, spark-plug gap, ignition cam angle, valve clearances, intake-air temperature, jacket coolant temperature, oil temperature, air-fuel ratio, exhaust back pressure, and rate of oil consumption are all maintained at specified standard operating conditions. The operating time is 36 hr unless excessive oxidation develops.

All data are recorded and at the conclusion of the test, the engine is disassembled and inspected. The parts are rated with respect to varnish and sludge deposit, as follows:

Varnish deposit	Sludge deposit
Piston skirts	Rocker-arm assembly
Cylinder walls, below ring travel	Rocker-arm cover
Rocker-arm cover	Push-rod cover plate
Push-rod cover plate	Oil screen
Crankcase oil pan	Crankcase oil pan

Definite limits are prescribed for every part of this comprehensive test so that the only variable will be the lubricating oil under test.

A numerical score is used in evaluation of these deposits.

A rating of 10 is given to parts free from deposits. A rating of 0 is given to parts on which the deposits have reached a maximum or actually have caused engine failure. A trace of deposit may depreciate the rating to 9.5 and a light deposit to 9.0 or even 8.5. Clear oil is not rated as deposit.

The copper-lead bearing halves are weighed to 0.01 gram to determine loss of weight. If visual inspection shows evidence of mechanical failure, this condition is noted in bearing loss report.

The ratings for each group are totalled and in order to qualify under Army Specification 2-104B and MIL 2104, a good motor oil must rate the following and must not fail on any of the 10 items of inspection:

Piston skirt	9.0 minimum
Total varnish	45.0 minimum
Total sludge	45.0 minimum
Weight loss	300.0 Mg. maximum per whole bearing

Any corrosive tendencies of the test oil are determined from the condition of the bearing and weight loss.

In addition to the L-4 test for oxidation, another critical test known as CRC designation L-1-545 is carried out for determining the effect of engine oil on ringsticking, wear, and the accumulation of deposits under endurance conditions.

This procedure will evaluate:

(a) The tendency of the engine oil to form materials in the ring grooves that bind the rings and prevent their free action, resulting in ring sticking.

(b) To form excessive lacquer deposits on pistons, causing poor heat transfer.

(c) To form deposits at the top of the cylinder, causing piston crown scuffing.

(d) The efficiency of the oil in reducing piston ring and cylinder wear.

The procedure involves the operation of a special one-ring cylinder diesel test engine 480 hours at fixed speed and BTU input, using the test oil as lubricant.

The engine is cleaned and reconditioned thoroughly before each test. A complete new piston assembly and cylinder liner are installed prior to each test run. A standardized fuel from the same source of supply is used in each series of tests.

Standard operating conditions are maintained rigidly throughout each test, including engine speed, fuel-injection timing, BTU input, (weight of oil) length of test, jacket-outlet coolant temperature, oil temperature to bearings, oil pressure to bearings, valve clearance, exhaust system back pressure. The crankcase blowby is recorded.

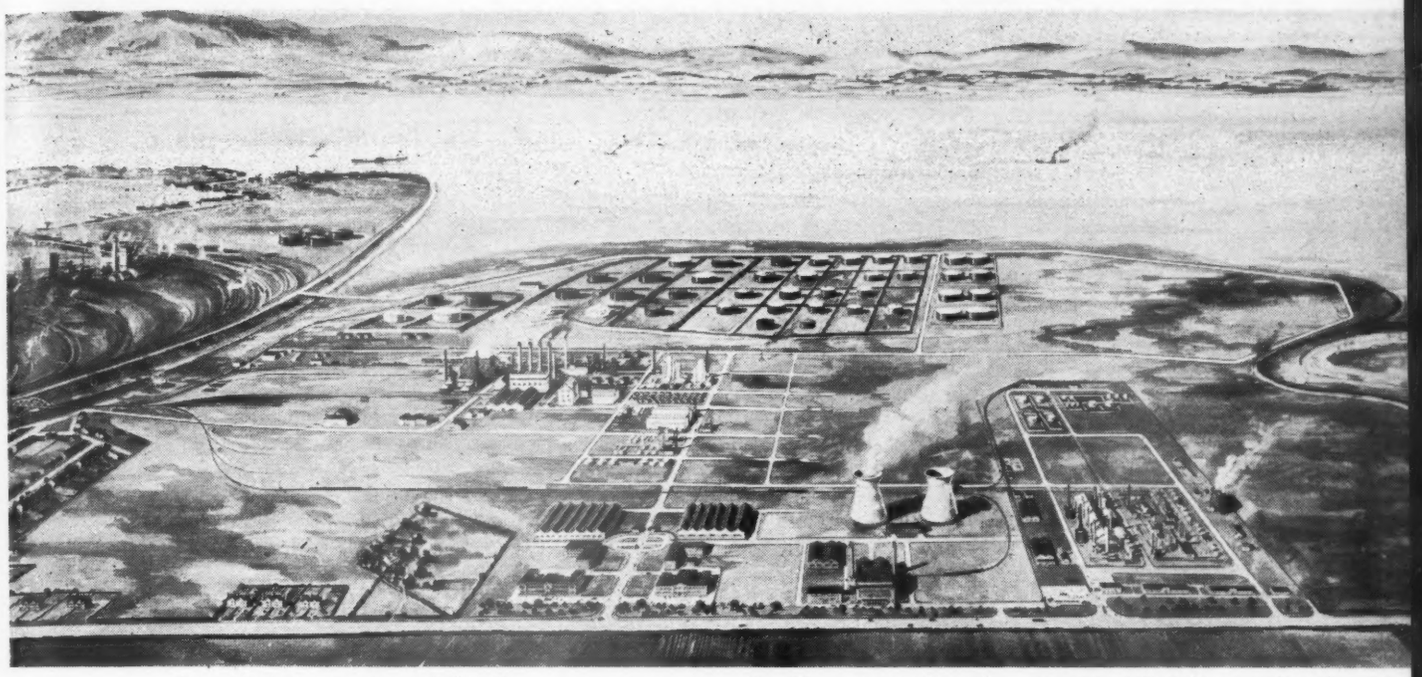
The cylinder liner, piston, and rings are inspected at the end of the test as follows:

Carbon deposits on liner above ring travel, around piston crown, in oil-ring slots, in ring grooves behind rings, on sides of ring grooves, on sides of rings, on ring lands, underside of piston, and piston skirt.

Cylinder liner condition (scratched or not scratched), piston-crown scuffing if any, condition of ring faces (if scratched), piston ring sharpness. Number of tight rings and number of stuck rings.

The liner is measured for wear in four positions. The top ring side clearance is measured before and after test.

In addition, the oil-filter element is inspected and samples of the used oil drawn at 120-hour intervals are analyzed thoroughly. * * *



An artist's impression of the Grangemouth scene as it will appear when the present project is completed.

Refinery Expansion in England

Postwar modernization and extension of refining facilities at Grangemouth and at Llandarcy will go far toward supplying the British Isles with needed products from domestic processing.

V. S. SWAMINATHAN

In 1850 Dr. James Young of Glasgow secured his patents for the refining of oil from coal, and the following year witnessed the opening of the first oil refinery at Bathgate in Scotland. It is fitting therefore that the centenary celebrations should mark the completion of the first stage of the new extended Grangemouth refinery of the Anglo-Iranian Oil Company, Ltd. It marks another forward step in the progress of the petroleum industry since Doctor Young did his pioneer work.

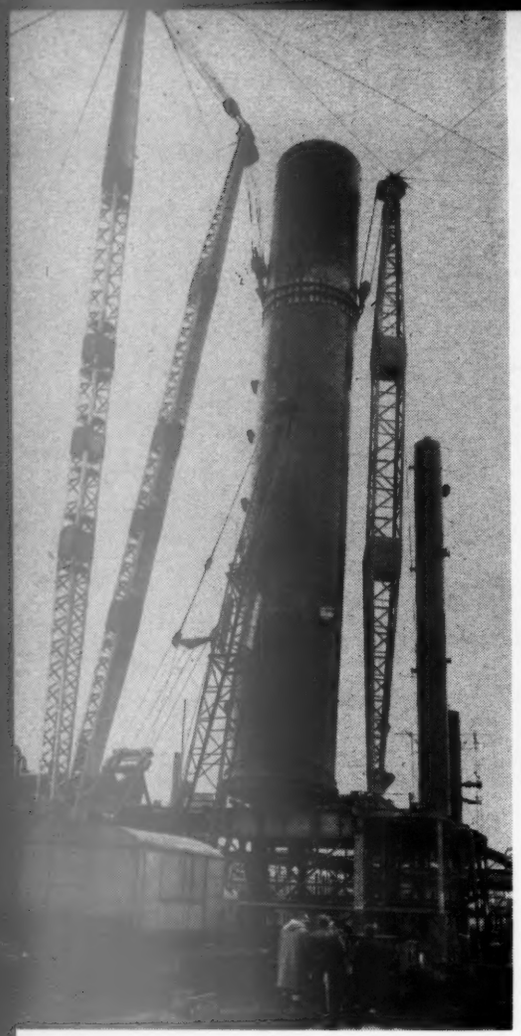
Grangemouth Refinery

The original Grangemouth refinery began operations in 1924. It may be recalled that only 5 out of a total of 120 once-registered shale oil companies survived the stiff economic struggle against American petroleum competition after the first World War. They were combined into Scottish Oils, Ltd., which in 1919 became an integral part of the then Anglo-Persian Oil Company. The Grangemouth refinery for the processing of imported oil was one result of the amalgamation.

The refinery was originally designed for a throughput of 360,000 long tons per annum, and for the manufacture of a limited range of products—motor fuel; kerosine and fuel oil—and the equipment was therefore of the simplest. There was one topping bench, consisting of a battery of 5 shell stills, a steam-heated redistillation shell still unit for the separation of kerosine from motor fuel; paddle-agitated batch washers for the refining of gasoline and kerosine and a bauxite plant for the final sweetening of kerosine. Auxiliary equipment embraced steam boilers with pass-out turbines for the production of caustic soda and hypochlorite of soda, pumphouses, workshops, offices, etc. One jetty situated within the Grangemouth dock area, handled inward and outward shipments, and a rack for the filling of railcars completed the despatching arrangements. The refinery was then operated and maintained by about 20 men and in fact during the night the staff on duty consisted of ten process workers under the control of a shift foreman.

These conditions were not destined to last long, however. Changing market requirements both for range and quality of products entailed continual additions and modifications to plant and in 1929 the first large-scale extension program was launched. Two continuous crackers with stabilizing equipment, an Edelaneau SO_2 plant, a Holly Mott washery and Ethyl blending equipment were installed, as well

EXCLUSIVE



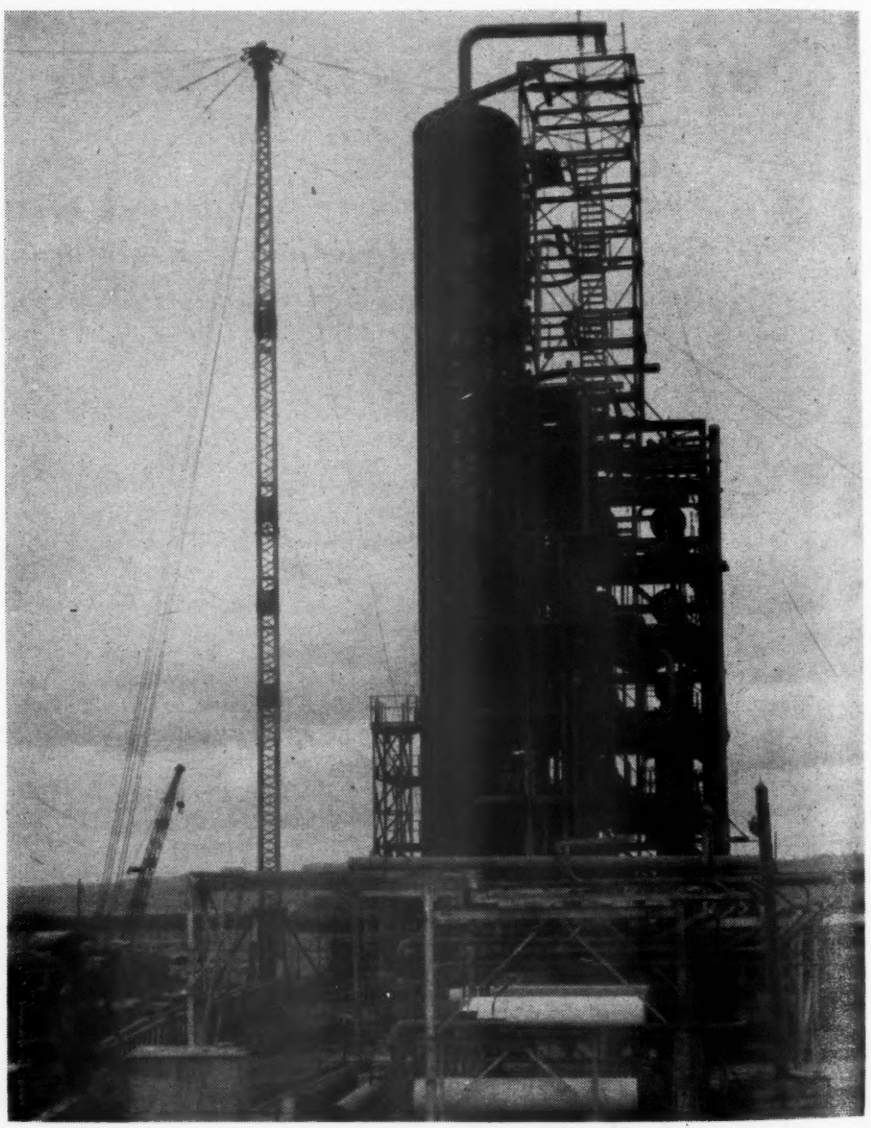
Lifting and placing in position the main fractionating tower of the large distillation unit for the Grangemouth refinery expansion project. The tower is 96 ft high, 13 ft in diameter and weighs, without its internal fittings, about 67 tons. It was manufactured in Scotland.

as additions to the power plant, workshops, jetties, etc. The throughput remained at the original figure, but the range of products turned out included premium and commercial motor fuels, two qualities of kerosine, tractor vaporizing oil, white spirit, rubber solvent, gas oil, and several grades of fuel oils.

During the next decade a steady output was maintained. No major additions were made to process equipment, but the refinery amenities received attention. More houses were built for the accommodation of staff and workers. Modern well equipped shower baths with locker rooms were installed in the refinery. Recreation facilities took the form of tennis courts, a bowling green, football field, and a clubhouse. The outbreak of war had almost immediate repercussions. It was found impossible to maintain crude oil supplies by shipments up the East Coast. So early in 1940 the refinery was shut down and placed on more or less a care-and-maintenance basis. Staff and labor dispersed—some to other theaters of the company's activities, some to local factories on munition work and many to the services. Only in July 1946 was the refinery recommissioned.

Post-war markets demanded quantity in the first place and for a start the refinery was run with this object in view. Cracking units were converted for the distillation of crude oil and all other units were adapted to give maximum output. By these means throughput was raised to 670,000 tons per annum. A large expansion scheme for Grangemouth, costing £12,000,000 ($33,600,000) is now under way. It is being executed in two stages. Initially it is proposed to install a modern pipestill distillation unit, complete with gas stabilizing equipment, as well as a complete range of treating plants for refining the various fractions. The new capacity will be 1,500,000 tons per annum. Forming part of Stage 1 is the new factory of British Petroleum Chemicals Ltd.—a joint Anglo-Iranian and Distillers venture—to manufacture a wide range of chemicals from a feed stock furnished by the refinery. It is to make ethyl and isopropyl alcohol for plastics and rayon industries, as well as supply products for the manufacture of pharmaceuticals, dyestuffs, and textiles. The chemical plant adjoins the refinery now undergoing expansion. A new steam boiler and a power plant of an installed capacity of nearly 20,000 kw are included in Stage 1 scheduled for completion in 1950. These, together with water pumping, cooling, and compressed air equipment are sited in a "Service Area" lying between the refinery and chemical factory. Power and steam requirements of both establishments will be supplied from this area.

Topping unit tower at Grangemouth refinery.



Value of "lead" to refiners increased by modern engine design

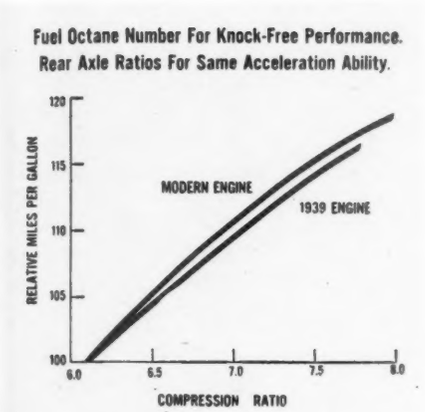


CHART 1. Effect of progress in engine design on increase in fuel economy from higher compression ratios.

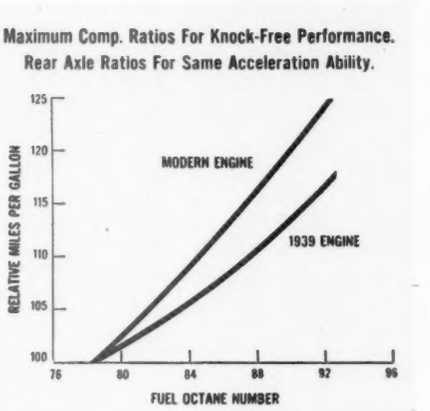


CHART 2. Effect of progress in engine design on increase in fuel economy from gasolines of better antiknock quality.

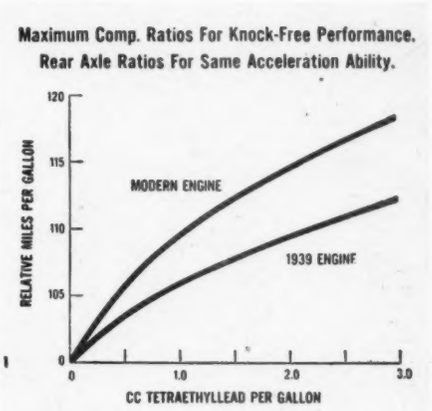


CHART 3. Effect of progress in engine design on increase in fuel economy from tetraethyllead added to average base for premium gasoline.

Today's engines of advanced design utilize fuel antiknock quality more effectively . . . enable tetraethyllead to deliver more miles per gallon to motorists.

Comparison of a 1939 engine and modern engine, both representative of the best design for each period, indicates that more effective use of octane numbers is being made today. In the Ethyl Laboratories extensive dynamometer data relating to engine performance and fuel antiknock quality were obtained on both engines. Later the engines were installed in cars so that complete data could be obtained on the road.

Modern design gives 10% improvement

When fuel of 78.3 octane number with proper compression ratio was used, the maximum brake mean effective pressure at 1000 revolutions was 104.3 lb. per square inch for the 1939 engine and 114.5 for the modern engine. Gasoline consumed per hour in the development of one horsepower at 1000 RPM and a throttle setting corresponding to a level-road speed of 20 MPH was 1.08 lb. for the 1939 engine and 0.91 lb. for the modern engine.

If the modern engine had been installed in the 1939 automobile and had been operated at the proper compression ratio for 78.3 octane gasoline, the acceleration and hill-climbing performance of the car would have been about 10% better and gasoline economy improved at least 10%.

Obviously the modern engine makes more efficient use of gasolines having antiknock quality typical of the late prewar period.

Better use of TEL at higher compression ratios

The charts compare the improvement in gasoline economy of the two engines as the compression ratio was increased to take advantage of the better fuels marketed since 1939.

Chart 1 shows the relative fuel economy as the compression ratio was increased from 6.1. The actual fuel economy of the modern engine at 6.1 compression ratio was better than that of the 1939 engine, as previously explained; however, as two different automobiles were used, the road fuel economy of each engine at 6.1 compression ratio has been arbitrarily established at a relative value of 100. The divergence of the curves indicates that the modern engine had about 11% greater rate of improvement in gasoline mileage as compression ratio was increased.

In the utilization of "chemical octane numbers," the modern engine is far superior. In addition to the aforementioned larger gain in economy *per compression ratio*, the modern engine permitted a considerably greater increase in compression ratio *per octane number*. The combined effect of these two advantages is indicated in Chart 2 which shows the relative percentage increase in gasoline economy of the same two engines on the road when the compression ratio was increased from that permissible with fuel of 78.3 octane number to that suitable for 92.8 octane fuel, at constant acceleration ability. The improvement for the 1939 engine was about 18%, whereas that for the modern engine was 25%, or 39% greater.

The more effective utilization of fuel antiknock quality by modern engines of advanced design enables tetraethyllead to deliver far greater benefits. This is illustrated in Chart 3, in which road-test data show that 3.0 cc tetraethyllead added to an average base stock for 1949 premium gasoline permits an increase in the compression ratio of the 1939 car which yields 12.3% gain in fuel economy. In the modern engine, the same amount of tetraethyllead yields 18.4% increase in fuel economy. Thus, in the modern engine, tetraethyllead is worth about 50% more in terms of gasoline economy.

Over 400 specialists working full time on fuel and engine developments

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"ETHYL" ANTIKNOCK COMPOUND — ETHYL CORPORATION

New atmospheric crude topping unit in foreground, Llandarcy refinery expansion project. Compare with artist's drawing.

Stage II, now under development and planned for completion by mid-1952, provides for the production of premium grade spirits and special products. It will include one of the most modern catalytic cracking units with a vacuum distillation unit to prepare its feed stock and a catalytic polymerization plant to produce a stable spirit from its "exhaust" gases. In addition there will be a treating plant to handle the products from the catalytic cracker, and small distillation and treating capacity for white spirit and other special products manufacture.

Two new jetties, additional storage tanks, despatching lines and pumps, and larger road and rail car filling sheds are included in the plan to cope with the increased two-way traffic. To accommodate the administrative and chemical staffs a new office and laboratory will be erected. These will be situated one on each side of the new refinery entrance gate, and designed to harmonize with the power station building lining up to the same frontage. Provision has been made for additional housing for the increased number of employees required for the refinery and the chemical factory. Early this year "buoyancy" foundations, to suit the difficult soil conditions, were under construction and roads, railroads, and pipe ducts are being laid in preparation for the erection of steelwork and above-ground structures. Work on the project is now proceeding at increasing momentum.

Llandarcy Refinery

The Llandarcy refinery of the National Oil Refineries Ltd. also owned by Anglo-Iranian, is also undergoing expansion involving an outlay of £9,000,000, ($26,200,000) towards which a $7,250,000 Marshall Aid allocation was made in 1949. This refinery, officially opened in June 1922, was originally laid out on the lines of the plant at Abadan but on a much smaller scale. It was designed to produce from Iranian crude, motor fuel, kerosine, gas oil, and residual fuel oil, coupled with a certain amount of lubricating oil and wax. Original annual input capacity of the refinery was about 360,000 long tons of crude oil, which was run in a double bench of shell stills. The distillate from this was them re-run in two oil-fired shell still benches. Production was later stepped up by the use of two redistillation benches for the crude oil; by building a further bench for crude distillation, and by installing a group of steam-heated stills for distillation of light distillate. This brought the aggregate annual refining capacity to 1,200,000 tons. The increased output entailed reshipment of considerable amounts of finished items to other areas since rail car and road vehicle distribution facilities were found inadequate. All the time the quality of products underwent constant improvement.

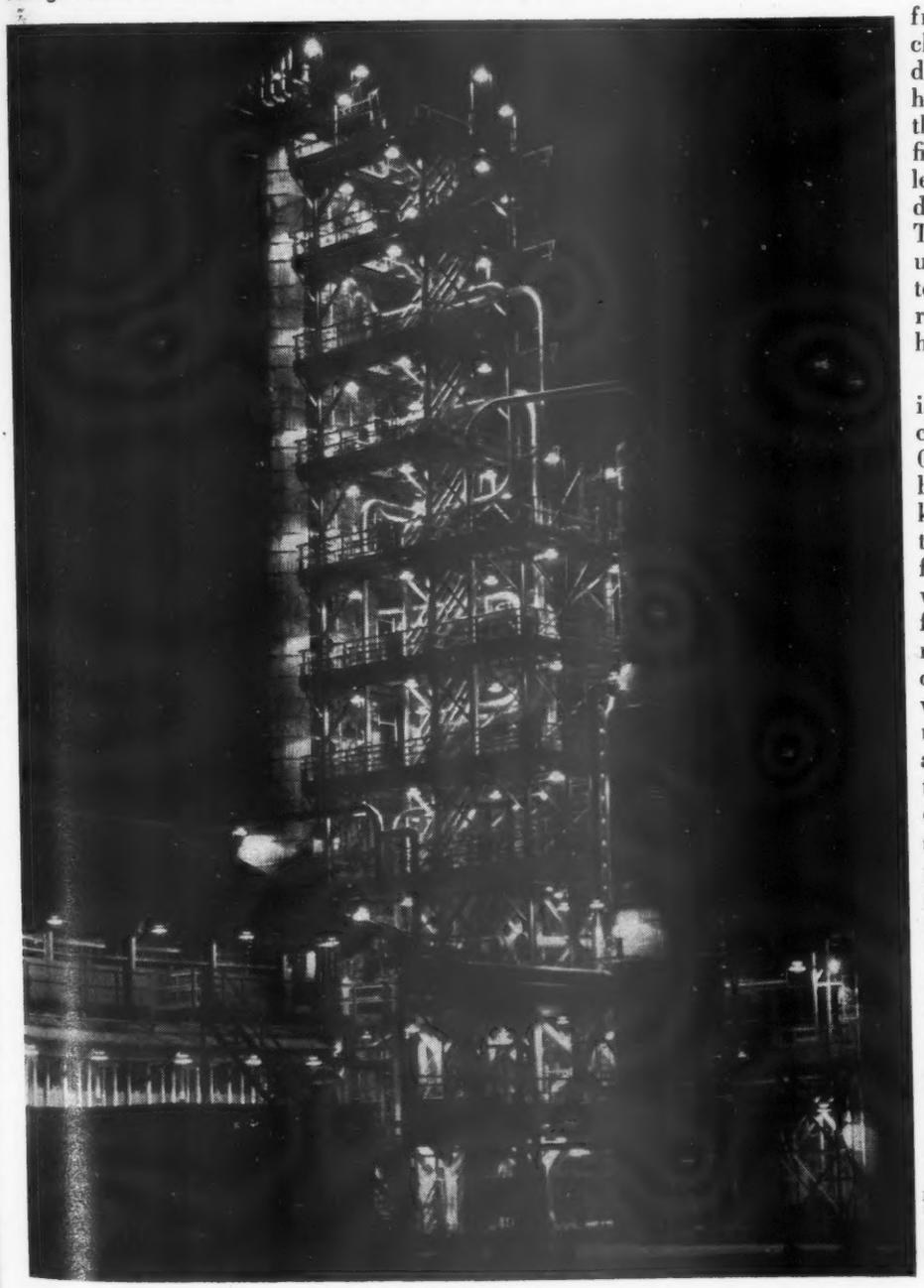
When the war ended the Llandarcy refinery worked on one main distillation unit producing all the various raw cuts. Refinery operations included SO_2-benzol extraction and dewaxing; sweating and pressing for

wax; Sharples centrifuging for dewaxing; continuous countercurrent treatment of light distillates with acid and hypochlorite; lubricating oil low temperature clay treatment and Alco high temperature clay treatment; gasoline recovery, and manufacture of various bitumen and rubber compounding products and paints. Distillation units comprised Badger crude topping and vacuum distillation unit with a throughput of about 14,000-15,000 gal of crude oil per hour; an older distillation unit processing 6000 gal of crude per hour; a revamped cracking unit with a throughput of 10,000 gal per hour; a Foster Wheeler primary distillation unit operating under vacuum and distilling 3300 gal of topped residue per hour to produce lubricating oil fractions and supplementing production by the other vacuum unit, and a Foster Wheeler secondary distillation unit to redistill lubricating oil at a throughput of 2000 gal per hour.

The first two columns yielded the following range of products; Gas, benzine, white spirit, kerosine and light gas oil. The vacuum column dealing with a portion of atmospheric residue produced heavy gas oil, the various lubricating oil fractions and a bitumen residue. Surplus residue from the atmospheric column went forward as fuel oil.

The refinery boilers were recently converted from coal to oil burning. They supply all the steam necessary for the processing of the refinery, as well as for the Siemens turbo-alternators in the power house. These alternators generating abut 2500 kw supplied only a fifth of the refinery's needs, the balance being met by the grid. The attached laboratory was largely concerned with the development of equipment and processes. It was laid out with benches to deal with all aspects of refining. In one of the rooms two petrol testing engines were installed. The Llandarcy refinery laboratory was responsible for the production of a plasticizer for PVC from lubricating oil extract. Other new products coming from it were wax additives for rubber compounding and a wide range of bituminous products of various melting points.

A night view of Bench "B" 40,000-bbl-per-day distillation unit.



Turning to transport, the Queen's Docks, Swansea, are about two miles from the refinery. Cargoes are discharged through pipe lines into the dock side transit site, which will soon have fifteen 10,000 ton tanks. From these crude oil is pumped to the refinery as required. There is an excellent training center for university students as well as the firm's employees. The staff and workers enjoy all the usual amenities. There are two canteens, baths and changing rooms, a recreational center, and a village for housing key personnel.

When the new Llandarcy project is completed by 1952 the refinery's crude throughput will go up to 2,000,-000-3,000,000 tons a year to obtain butane, benzine, white spirit, normal kerosine, colorless kerosine, lubricating oil, bitumen, light fuel oil, and furnace oil. Working in conjunction with it will be a 500,000-ton-a-year fuel oil importation scheme. Main new units to be installed comprise a crude oil atmospheric distillation unit, vacuum distillation unit, redistillation unit, gas stabilizer unit, propane deasphalting unit, solvent extraction unit, solvent de-waxing unit, wax recrystallization unit, wax decolorization unit, wax slabbing unit, high temperature clay treatment plant, SO_2 extraction plant for kerosine refining, thermal reformer to provide motor fuel of high octane rating, bitumen air blowing plant, and treatment plant for general refining purposes.

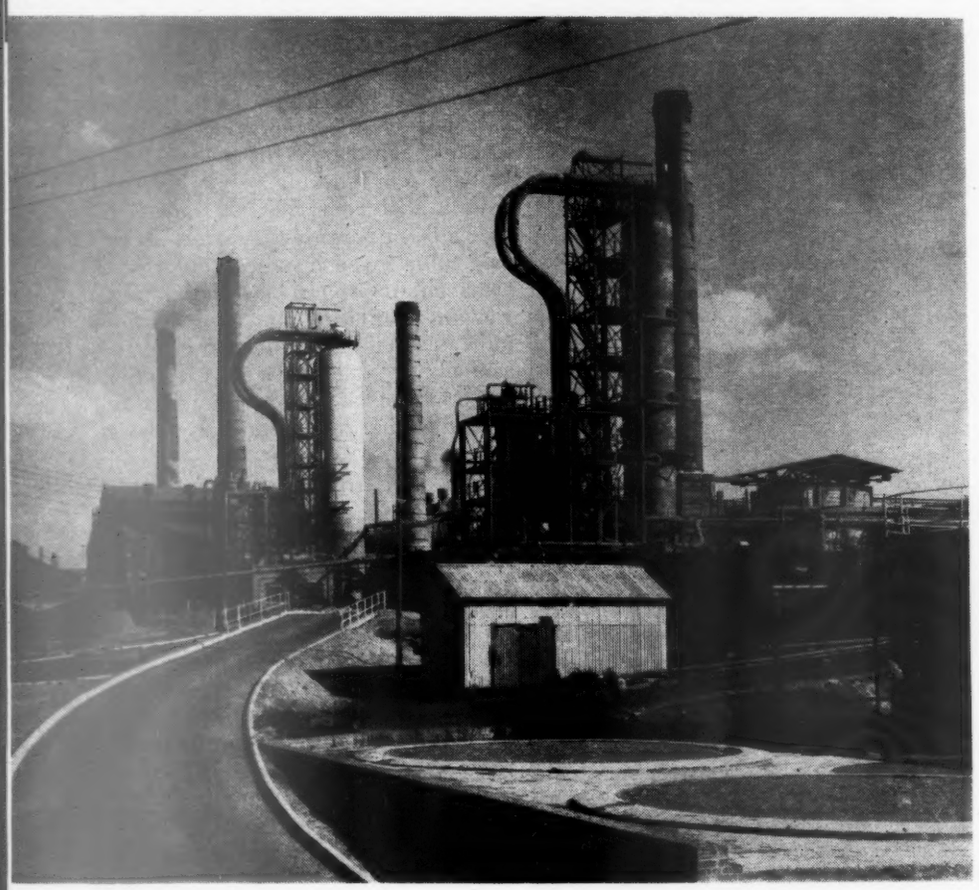
Work of clearing the site began at the end of June, 1948, and erection of pipe heater columns and pumphouses were under way by January the following year. They were completed in September 1949, as also testing and oil circulation. Last October (1949) a 40,000-bbl a day crude distillation unit—the first big unit of its kind to be built

in Britain since the war—went on stream. It will virtually treble the capacity of the refinery. It consists of a primary tower 12 ft in diameter and 135 ft high. The primary and secondary heating services are combined in one large pipe heater of a rated capacity of 108,000,000 Btu day. It is designed to run on Middle East crude stock. The new branch covers nearly two acres and contains 2300 tons of steel above ground.

A new power station, including a high pressure boiler plant with a steaming capacity of 30,000 lb per hour and an electricity generating capacity of 15,000 kw, is rising. The enlarged refinery's electricity demand will continue to be met by the grid and the balance will be generated in back pressure turbines. Cooling water supplies have been augmented by the erection of a 20,000,000 gal per day natural draft cooling tower together with pumphouses, separators, and water lines. The cooling tower is 230 ft high and 163 ft in diameter, and is of the "cotton spool" shape, which is fast becoming a familiar feature of the country's landscape. The entire refinery cooling system now circulates close on 40,000,000 gal of water per day. Another three to four million gallons a day of water is needed for the make-up of chemicals for processing, and a million for domestic use.

Bench "A" atmospheric vacuum unit at the Llandarcy refinery.

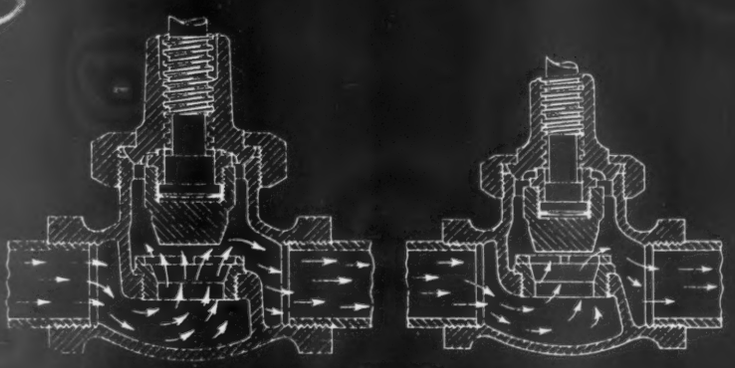
Vacuum units and boiler house at the National Oil Refineries, Ltd. plant.



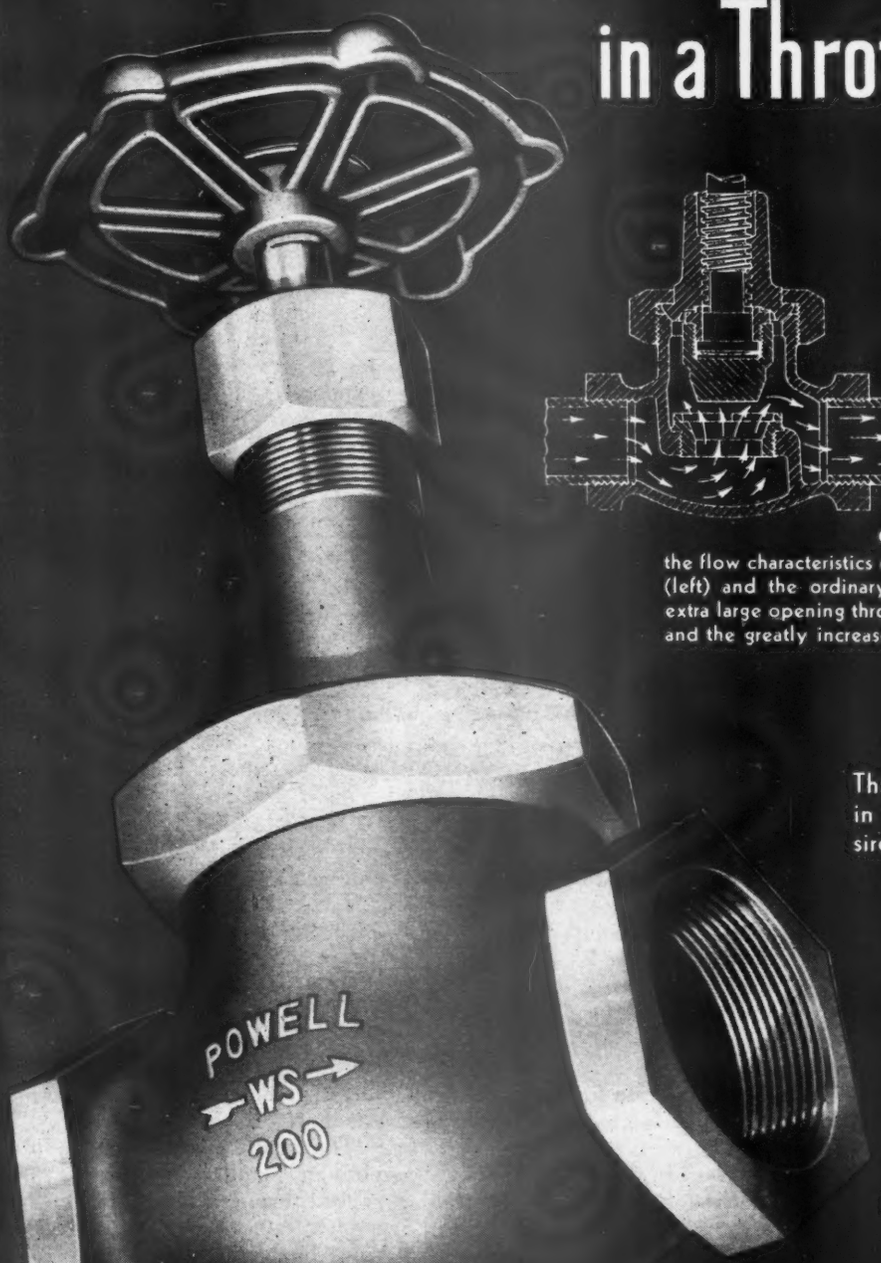
The crude oil is drawn by pipe line from Queen's Dock. Finished products can also be returned to the dock by product lines for reshipment. In the dock area the old wooden jetties are being replaced by five new reinforced concrete structures of the latest design. Considerable extensions to pumps, pipelines, and small tankage are in progress to deal with the increased refinery output. Packing and blending plants for lubricating oils and waxes are being added to, as also road, rail and despatch facilities.

Additional plant is under construction for the separation of oil and water from effluent and new drainage systems to River Neath to cope with the increased volume of effluent are planned. A new chemical development laboratory forms an integral part of the expansion project as well as additional fire-fighting facilities and a new ambulance station. The entire project will consume about 30,000 tons of steel, 3000 tons of cast iron, 10,000 tons of cement and 5,000,000 bricks, and will employ 2000 workers during the peak period of construction activity. The Llandarcy refinery will be among the first completions in the British plans for the expansion of home refining. * * *

POWELL gives you *Full Flow* in a Throttling Valve



COMPARE
the flow characteristics of the new Powell "W.S." Valve (left) and the ordinary globe valve (right). Note the extra large opening through the seat (nominal pipe size) and the greatly increased lift of disc, when wide open.



This is actually a dual service valve in that it can be throttled to any desired degree, yet, when wide open, permits FULL FLOW through the body. Thus turbulence and pressure drop are reduced to a minimum—a triumph in engineering that exemplifies Powell's continual leadership in the field of industrial valve design.

Powell "W. S."
Bronze Globe Valve
Fig. 2608

Write for folder giving full description of the many advanced engineering features of this valve.

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Motor Selection for Hazardous Locations*

J. C. LINSENMEYER†

MANY industries as petroleum, chemical, mining, flour, and grain, to mention but a few, have, besides the normal electrical equipment application problems, the added headache imposed by operation in a hazardous atmosphere.

If all economic factors could be forgotten, then perhaps a very short, safe, and simple rule might be made for the selection of motors for hazardous locations.

Such a rule might simply state that for any application where there might be the slightest chance that a hazardous condition could exist—the electric motor should be of the enclosed explosion proof type.

The term explosion proof is defined in the National Electric Code as meaning "enclosed in a case that is capable of standing an explosion of a specified gas or vapor that may occur within it and of preventing the ignition of the specified gas or vapor surrounding the enclosure by sparks, flashes, or explosions of the gas or vapor within."

The economics cannot be ignored, however, and there are many factors that must be considered. Local insurance regulations, as well as national, state, and city codes, frequently will be big factors in influencing this selection.

Unfortunately the many variations in operating conditions and requirements make it impossible to give any specific recommendations or rules to cover the vast number of different industrial applications. This paper, therefore, will describe various types of motors that are available and illustrate some of the applications that have been made.

The squirrel cage induction motor with its entire absence of collector rings, brushes, or open electrical contacts of any kind, is frequently applied without any form of special enclosure in Division 2 locations (hazardous only under abnormal conditions).

For similar applications, the wound rotor type of induction motor, and the synchronous motor have been built with an enclosure housing the slip rings and brushes, which are subject to sparking, the rest of the unit being of open, drip-proof, or splash-proof construction as desired. Fig. 1 shows two 125-hp, 8-pole open wound rotor induction motors driving the draw-works on a rotary type oil well drilling rig. A totally enclosed explosion-resistant housing encloses the slip rings and brush assembly.

When properly installed and maintained, the fire hazard in the open squirred cage motor and with the open wound rotor and synchronous motors having enclosed collector rings is extremely low. On the other hand, it is appreciated that in many cases the motors are installed in remote and rather inaccessible places, and very little if any attention may be given such drives. For this reason, the fire insurance companies have for many years on various applications recommended motors properly enclosed and have made preferential rates for same. There is, of course, an appreciable difference in cost between a motor of open construction and an explosion proof unit.

Frequently, it is possible to separate the motors from the hazardous area by the use of a fire-wall. When a fire-wall is used the motor location is treated either as a non-hazardous location or as a division 2 location, and squirrel cage motors of the open construction or with enclosures for mechanical protection only may be used. Providing a separate fire-proof motor room naturally increases the cost of building construction, but it permits the use of less expensive motors.

Where the room separating the motors from the hazardous area is relatively small and where the motors are say 250 hp and above, considerable lost heat must be removed from the room, and it is advantageous to install motors having open or drip-proof end brackets and enclosed frames arranged for air discharge through ducts leading to the outside of the building. Typical of this process is the installation of 1250-hp motors shown in Fig. 2. Air enters the ends of these motors and discharges at the top of the frame into a duct leading to ventilators on the roof of the building. The inconvenience of this overhead duct may be avoided by installing motors with air discharge in the bottom of the frame into underfloor ducts terminating on the outside of the building. The installation of underfloor duct work is usually more expensive, however.

Where it is unreasonable to use the fire-wall, the motors must operate in a hazardous atmosphere, and must be constructed so as to be suitable for the particular conditions involved.

The totally enclosed fan-cooled motor with its non-sparking blower, which prevents the formation of sparks even in a gritty atmosphere, offers a simple and reliable installation for such applications as met in flour and grain mills. Fig. 3 shows a cutaway view of a totally enclosed fan-cooled motor suitable for application in a Class 2, Group F and G locations. Class 2, Group G, covers atmospheres containing carbon-black, coal, or coke dust. Group F covers atmospheres containing grain dust. For these locations it is not required that the motor be explosion proof, but the enclosure must be such that the dust cannot enter. Consequently all of the joints or seams in the fabricated steel frame must be made to fit tightly to seal out the dust.

In this construction, ventilation is provided by an internal circulating air system and an external cooling air system.

Placed around the end turns at each end of the motor are copper fins fabricated with steel parts to form large cylindrical air-to-air heat exchangers.

The stator core is made up with circular copper punchings equally spaced throughout the steel core. The copper punchings have a larger outside diameter than the steel punchings, resulting in a concentric layer of copper fins. Each copper fin extends from the internal air path, into the external air path providing a copper path for the heat flow.

External cooling air is drawn into both ends of the motors by uni-directional shaft mounted blowers. It is forced through the external ring of the copper fin on the cylindrical heat exchanger and directed by baffles on the circular copper fins of the stator core to discharge openings on the sides of the motor.

With this form of design the heat transferred to external cooling air is almost as effective as on open motors.

*Presented at the AIEE Winter general meeting, New York, New York, January 30-February 3, 1950.

†Westinghouse Electric Corporation, East Pittsburgh, Pennsylvania.

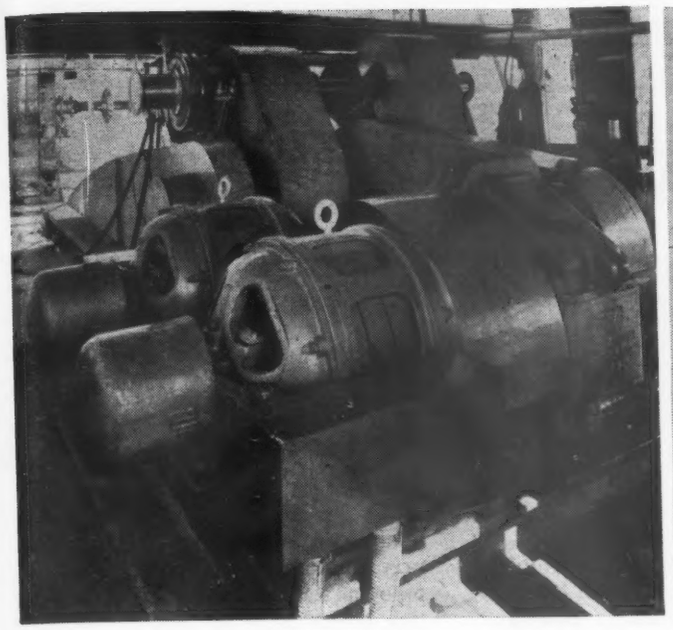


FIG. 1

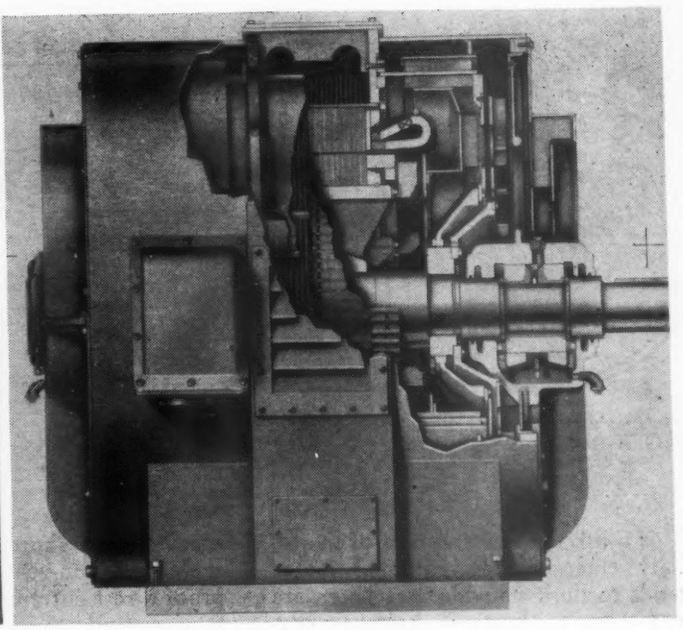


FIG. 3

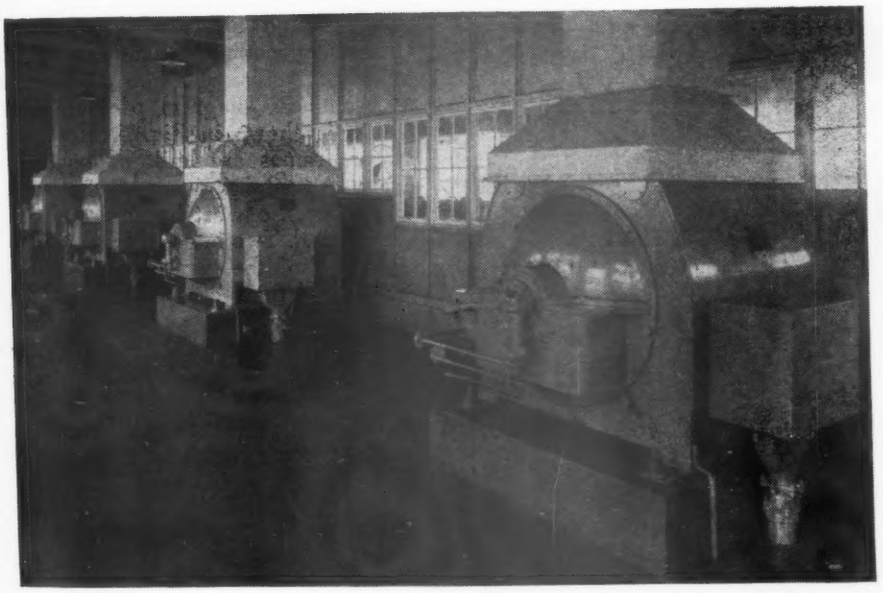


FIG. 2

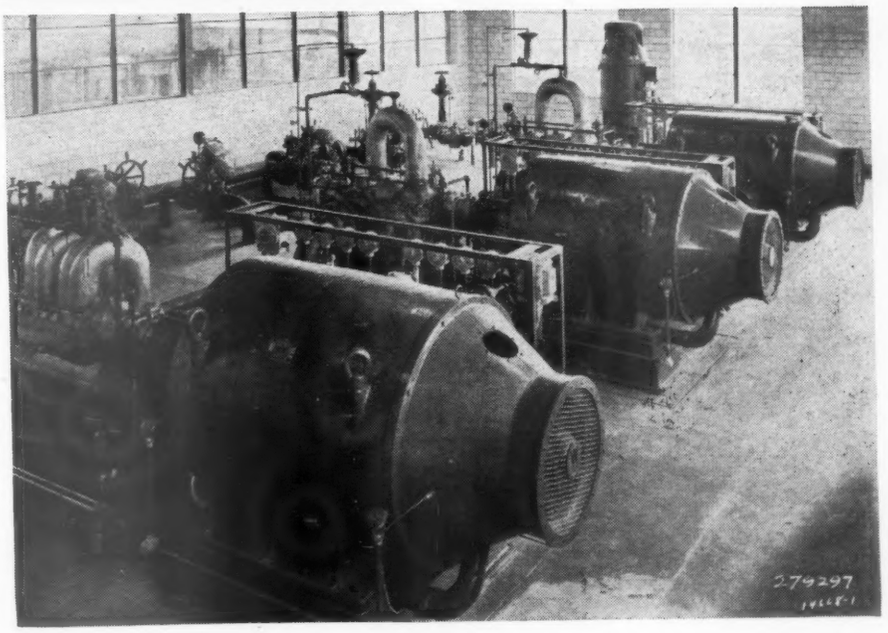
FIG. 4

FIG. 5

This permits keeping the frame size for a given rating to a minimum.

The National Electric Code specifies that for Class 1 Division 1 locations the rotating electrical equipment shall be of the enclosed explosion proof type.

The totally enclosed non-ventilated explosion proof motor is the simplest form of construction and is ideal for many applications, but because there isn't any ventilating air to cool the motor windings, a totally enclosed motor for ratings above 5 hp has a capacity for approximately only 25 to 35 per cent of the continuous rating of an open motor of the same frame size. Therefore, for all except the smaller ratings, that is up to perhaps



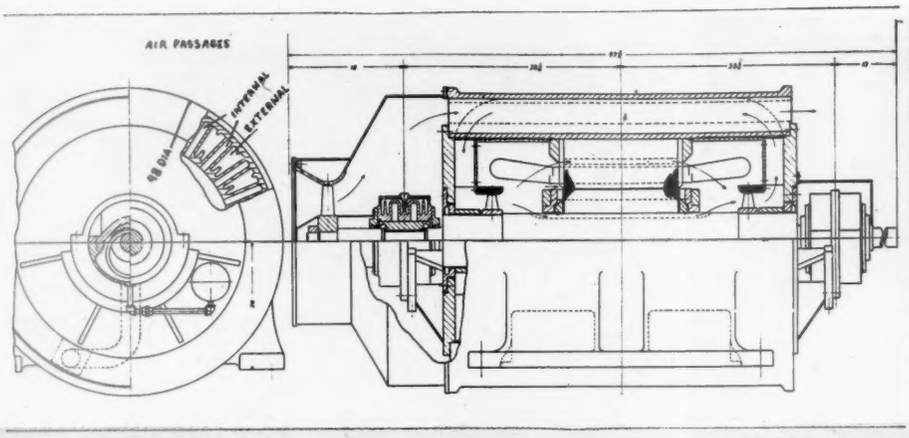


FIG. 6

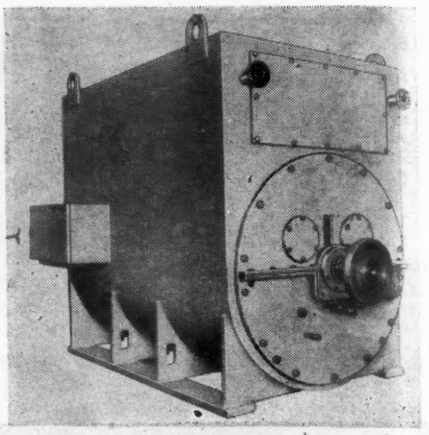


FIG. 7

3 or 5 hp, the size and cost of the totally enclosed non-ventilated motor tends to limit its wide use. There are numerous applications, however, particularly in the coal mining industry, where the conditions are such that this form of construction must be used. Fig. 4 shows a 30-hp, totally enclosed, non-ventilated, explosion proof direct current traction type motor for application on a mine locomotive and designed to the specifications of the United States Bureau of Mines.

Fig. 5 shows three 900-hp, 3600-rpm totally enclosed, fan-cooled, explosion proof motors driving pumps in an oil pipe line station. Because this construction offers the maximum in safety to personnel and equipment, there has been a demand for larger and larger motors of this design, and they are now available approved for Class 1 Group D locations in ratings up to 1250-hp, 2-pole, and 800-hp, 4-pole.

A cutaway diagram of these machines is shown in Fig. 6. Here the motor frames are built as heat exchangers containing two separate sets of air ducts, one set internal and one set external. Two internal fans, one on each end of the rotor, circulate the air around the motor cores, air gap, and windings, thus, picking up whatever heat is produced by the motor losses. This warm air flows through the internal duct of the frame giving up the heat to the duct walls which in turn are cooled by a blast of air forced

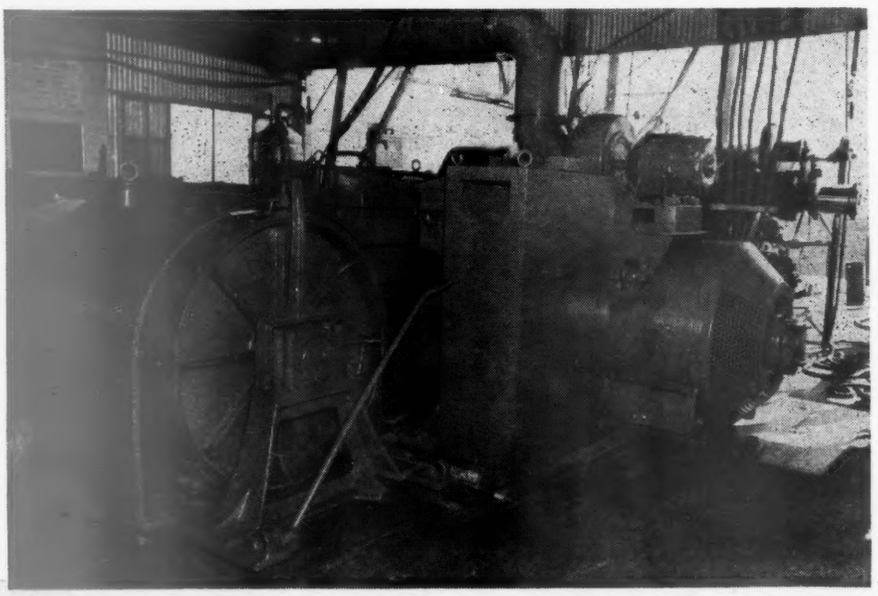


FIG. 8

FIG. 10

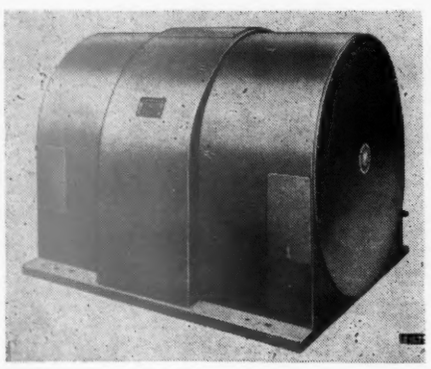
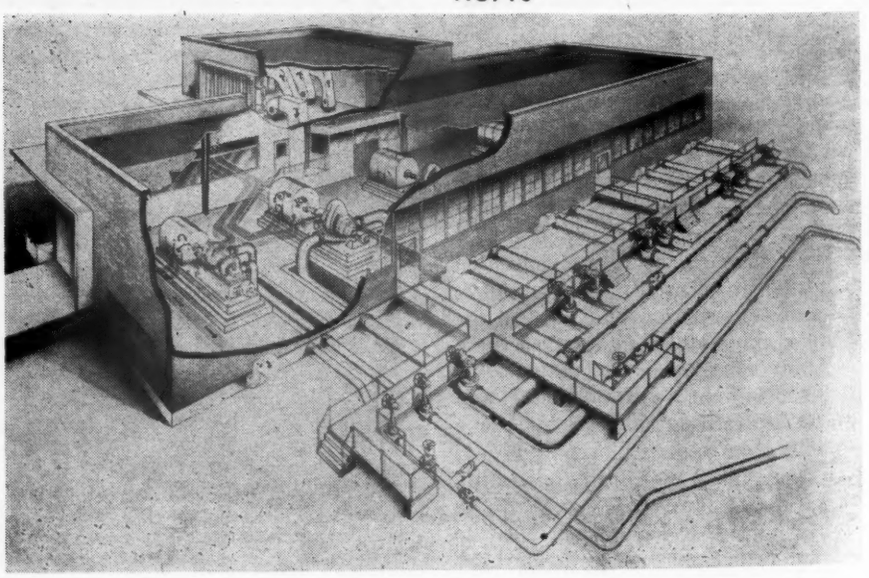
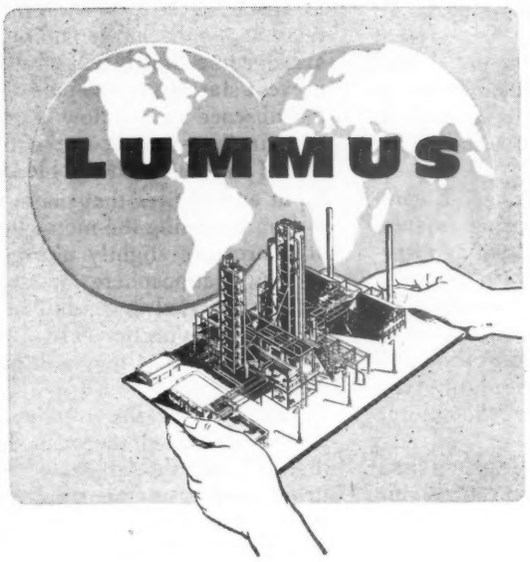


FIG. 9





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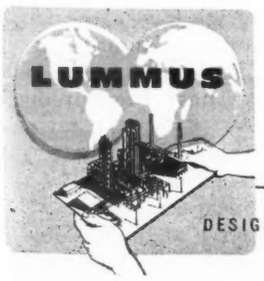

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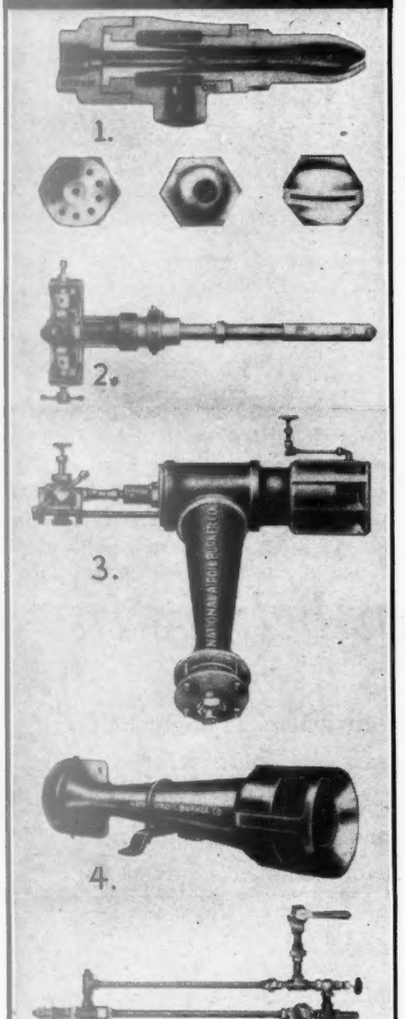

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through the external ducts by another fan on the front end of the motor shaft. Discharge of the warm air is at the rear or driving end of the motor.

For ratings exceeding the present capacity of the explosion proof construction the inert gas filled motor is available. This type has been built in ratings as large as 2250 hp, and larger ratings are available.

This unit, as shown in Fig. 7, comprises a closed ventilating system filled with an inert gas, such as nitrogen, maintained under a pressure slightly above that of surrounding atmosphere to prevent infiltration of outside air. Cooling is accomplished by passing the gas around fin type water coolers built in the motor housing.

Motors of this design cost less than the fan-cooled explosion proof motor in ratings above 700 hp 3600 rpm or 500 hp 1800 rpm. For smaller ratings the explosion proof is less expensive. This construction has the disadvantage of many accessories, however, such as water supply and control system, water coolers, gas supply and control, and the gas seals around the motor shaft. Each of these auxiliaries will require periodic inspection and maintenance.

Where a supply of safe air is readily obtained, the totally-enclosed, forced ventilated motor is sometimes used, and this construction is available in the higher ratings, beyond the ratings practical in explosion proof construction.

An example of the use of forced-ventilated motors is the direct current motor shown in Fig. 8, driving the "drawworks" on an oil well drilling rig. A blower driven by a totally-enclosed non-ventilated explosion proof motor is mounted on top of the motor. Safe air drawn in through the overhead duct is forced through the motor and expelled at the commutator end. With this arrangement of sucking in the safe air the duct is at a lower pressure than the surrounding atmosphere, and it is necessary to give particular attention to gasketing of the duct work to prevent unsafe air leaking in.

A larger forced ventilated squirrel cage type induction motor is shown in Fig. 9, and a more elaborate installation is shown in the layout of the crude oil pipe line pumping station in Fig. 10.

An individual ventilating duct system is provided for each motor, pressurized by a blower at the air intake and discharging outside the pump room.

The control system is arranged to purge the duct system by starting the blower before starting the pump motor. While in operation the blower maintains the entire duct system under pressure of ventilating air, preventing any seepage of hazardous atmosphere from the pump room. This is insured by installing an explosion proof vane relay at the discharge end of the duct arranged so that it will shut down or prevent starting of the pump motor in the absence of air flow. Location of the air flow switch at the discharge end of the duct and the blower at the input end insures that the entire duct system including the motor housing is at a pressure slightly above the surrounding atmosphere. Wiring to the motor is carried in conduit in the duct work, and connections are made under the motor so that they will be in safe air.

The cost of the totally enclosed forced ventilated motor is less than that of either the fan-cooled explosion proof motor or the inert gas filled motor, but similar to the inert gas motor it has the disadvantage of depending upon auxiliary equipment for proper operation. Also, the installation expense of the blower and duct ventilating system must be taken into account and, particularly if it is necessary to go to a great distance to obtain safe air, the cost of the duct work and blowers will tend to offset the difference in motor costs. * * *

Cold Rubber Process

A continuous cold rubber process has been described by Marvin W. Larson of the B. F. Goodrich Chemical Company, Cleveland, Ohio. Cold rubber, familiar to most motorists by now as a source of tire rubber superior to the synthetic rubber produced during the last war, was until recently produced by a batch method involving a 16-hour mixing period in a batch kettle. Larson reported how the B. F. Goodrich chemical engineers successfully overcame the obstacles in their path to convert the Goodrich-operated RFC plant at Port Neches, Texas, from batch operation to a continuous process. Larson spoke at the 43rd annual meeting of the American Institute of Chemical Engineers.

The new system permits continuous feeding of ingredients and results in a steady stream of liquid rubber latex. The conversion increased the capacity of the plant by about 20 per cent, lowered production costs, improved product quality, and resulted in better process and plant control. According to Larson, more than 65,000,000 lb of cold rubber have been produced by this process.

Besides discussing reports such as the one described above, the 1500 or more chemical engineers and executives registered at the meeting in Columbus visited some 29 industrial and research establishments.

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The Technical Forum

Packed Columns for Multicomponent Absorbers and Fractionators

Q Have any data been published which may be used for the estimation of the height of a transfer unit for packed towers filled with commercial packings used as absorbers for multicomponent hydrocarbon systems? —R. E. S.

A Recent developments and applications of new commercial vapor-liquid contacting devices have indicated interesting possibilities of different equipment than the conventional bubbleplate. This naturally raises the technical question: "How much packing will be required for a given separation?"

Engineers accustomed to thinking in terms of theoretical equilibrium stages and plate efficiencies in bubble plate calculations, are inclined to tackle packed columns separation problems in terms of theoretical equilibrium stages and HETP (height of an equilibrium theoretical plate) in computing the required height of packing. This is not strictly correct and may lead to serious errors. The correct procedure is to make fundamental mass transfer (vapor to liquid and vice versa) calculations and use HTU (height of a transfer unit) in computing the required height of packing.

The mass transfer approach is somewhat analogous to heat transfer calculations except that material is transferred in both directions whereas heat is only transferred from the high to the low temperature. In both heat and mass transfer one may use either overall transfer coefficients or individual film resistances, the latter being more fundamental.

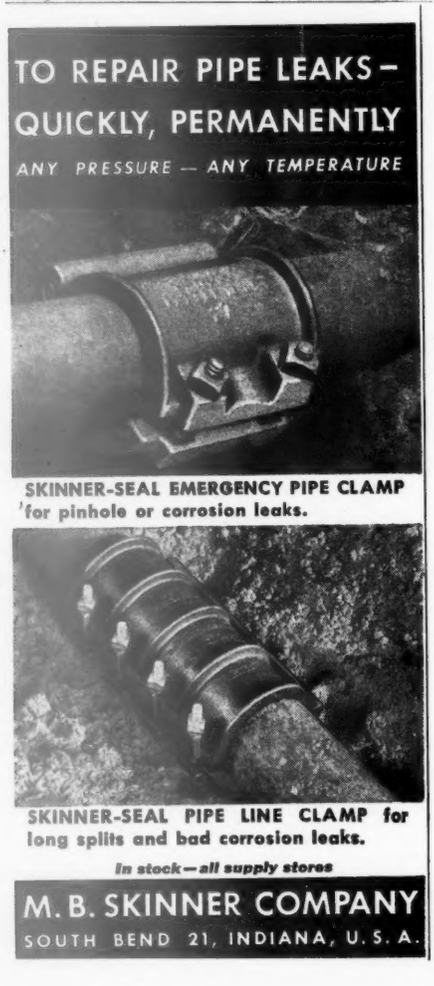
In packed column design and operation an important consideration is column flooding. Vapor and liquid flow countercurrently through the packing. Reasonably high velocities are desirable for good efficiency. Liquid and vapor loads that are too high will result in flooding, however.

The following bibliography lists 86 important recent articles on this subject. *Wayne C. Edmister*

BIBLIOGRAPHY

1. Arnold, J. H., "Kinetic Theory of Diffusion in Liquid Systems" J. Am. Chem. Soc. 52, 3937 (1930).
2. Aston, J. G., Lobo, W. E., Williams, B., "Liquid Air Fractionation," Ind. Eng. Chem. 39, 718 (1947).
3. Baker, T. C., Chilton, T. H. and Vernon, H. C., "The Course of Liquor Flow in Packed Towers," Trans. Am. Inst. Chem. Engrs. 31, 296 (1935).
4. Bain, W. A., Jr., and Hougen, O. A., "Flooding Velocities in Packed Columns," Trans. Am. Inst. Chem. Engrs. 40, 29-50, 389-407 (1944).
5. Benedict, M., "Multistage Separation Processes," Chem. Eng. Prog. 43, 41-60 (1947).
6. Bertetti, J. W., "Theoretical Flooding Velocities in Packed Towers," Trans. Am. Inst. Chem. Engrs. 38, 1023-1036 (1942).
7. Berg, C. and James Jr., I. J., "Rate of Approach to Equilibrium of Fractionating Columns," Chem. Eng. Progress, 44, 307-314 (1948).
8. Bowman, J. R. and Briant, R. C., "Theory of Performance of Packed Rectifying Columns," Ind. Eng. Chem. 39, 745 (1947).
9. Bragg, L. B., "Semi Commercial Columns for Fractionation—Triangular Pyramid Type Stedman Packing," Ind. Eng. Chem. 33, 139 (1937).
10. Bragg, L. B., "Packed Columns for Close Fractionation—Stedman Packing," Trans. Am. Inst. Chem. Engrs. 37, 19-50 (1941). Petroleum Refiner 20, 55 (1941).
11. Bragg, L. B. and Morton, F., "Precise Commercial Fractionation in a 1000 Barrel Stedman Unit," 22nd Annual API Meeting, San Francisco, November 6, 1941. (Also See:— Heat Engineering, Foster Wheeler Company October 1941.)
12. Cannon, M. R., "New Distillation Packing," Ind. Eng. Chem. 41, 1953-55 (1949).
13. Chilton, T. H. and Colburn, A. P., "Mass Transfer (absorption) Coefficients," Ind. Eng. Chem. 26, 1183 (1934).
14. Chilton, T. H. and Colburn, A. P., "Distillation and Absorption in Packed Columns—A Convenient Design and Correlation Method," Ind. Eng. Chem. 27, 255, 977 (1935).
15. Colburn, A. P., "The Simplified Calculation of Diffusional Processes," Trans. Am. Inst. Chem. Engrs. 35, 211 (1939), 36, 679 (1940).
16. Colburn, A. P., "Simplified Calculation of Diffusional Processes," Ind. Eng. Chem. 33, 459 (1941).
17. Cooper, C. M., Christl, R. J., and Peery, L. C., "Packed Tower Performance at High Liquor Rates," Trans. Am. Inst. Chem. Engrs. 37, 979-996 (1941).
18. Coulter, K. E., "Distillation Column Design for Processing Polymerizable Compounds," Chem. Eng. Prog. 45, 227-234 (1949).
19. Deed, D. W., Schultz, P. W., Drew, T. B., "Comparison of Rectification and Desorption in Packed Columns," Ind. Eng. Chem. 39, 766 (1947).
20. Dicks, R. S. and Carlson, C. S., "Extraction Distillation of Hydrocarbon Mixtures in a Packed Tower," Trans. Am. Inst. Chem. Engrs. 41, 789-804 (1945).
21. Duncan, D. W., Kottolt, J. H. and Withrow, J. R., "The Effect of Operating Variables on the Performance of a Packed Column Still," Trans. Am. Inst. Chem. Engrs. 38, 259-282 (1942).
22. Fairbanks, D. F. and Wilke, C. R., "Diffusion Coefficients in Multicomponent Gas Mixtures," In. Eng. Chem. 42, 471-474 (1950).
23. Fisher, A. W. and Bowen, R. J., "Performance of Stainless Steel McMahon Packing," Chem. Eng. Prog. 45, 359-369 (1949).
24. Forsythe, W. L., Stack, T. G., Wolf, J. E. and Conn, A. L., "Performance of McMahon Packing—Tests in a 6 in. Diameter Fractionating Column," Ind. Eng. Chem. 39, 714 (1947).
25. Furnas, C. C. and Taylor, M. J., "Distillation in Packed Towers," Trans. Am. Inst. Chem. Engrs. 36, 135-172 (1940).
26. Gaffney, B. J. and Drew, T. B., "Mass Transfer from Packing to Organic Solvents in Single-Phase Flow Through a Column," Ind. Eng. Chem. 42, 1120-1126 (1950).
27. Garber, H. J. and Lerman, F., "Principles of Stripping Operations," Trans. Am. Inst. Chem. Engrs. 39, 113-131 (1943).
28. Gilliland, E. R., "Diffusion Coefficients in Gaseous Systems," Ind. Eng. Chem. 26, 681 (1934).
29. Herman, A. and Kaiser, R. R., "Distillation of Ethanol in a Fibreglas Packed Tower," Trans. Am. Inst. Chem. Engrs. 40, 487-496 (1944), 41, 143 (1945).
30. Hobson, M. and Thodos, A., "Mass Transfer in Flow of Liquids Through Granular Solids," Chem. Eng. Prog. 45, 517-524 (1949).
31. Hougen, C. A. and Watson, K. M., "Chemical Process Principles, Part 3," John Wiley & Sons, Inc. New York, Chap. 20, (1947).
32. Houston, R. W. and Walker, C. A., "Absorption in Packed Towers," Ind. Eng. Chem. 42, 1105 (1950).
33. Hufferd, R. W. and Krantz, H. A., "Laboratory Size Continuous Distillation Unit," Ind. Eng. Chem. 33, 1455-1459 (1941).
34. Jesser, B. W. and Elgin, J. C., "Studies of Liquid Holdup in Packed Towers," Trans. Am. Inst. Chem. Engrs. 39, 277-298 (1943).
35. John H. J. and Rehberg, C. E., "Simplified Wire-Screen Packing for Fractionating Columns," Ind. Eng. Chem. 41, 1056-1057 (1949).
36. Johnstone, H. F. and Pigford, R. L., "Distillation in a Wetted-Wall Column," Trans. Am. Inst. Chem. Engrs. 38, 25-52 (1942).
37. Kirschbaum, E. (Translation by Wulfinghoff), "Distillation and Rectification," Chemical Publishing Co. Inc., New York pp 307-336 (1948), (original publication, 1939).
38. Kirschbaum, E., "Fractionating Performance and Pressure Drop in Packed Towers," Z. Ver deut, Ing. Verfahrenstech. 1941 53-8. See also Chem. Zentr 1942 I, 650.
39. Kirschbaum, E., "A Method for the Determination of the Height of Packed Columns in Distillation and Rectification Practice," Z. Ver deut. Ing. Verfahrenstech 1943, No. 1 15-20.
40. Lewis, W. K. and Whitman, W. G., "Principles of Gas Absorption," Ind. Eng. Chem. 16, 1215-1220 (1924).
41. Linton, W. H., Jr. and Sherwood, T. K., "Mass Transfer from Solid Shapes to Water in Streamline and Turbulent Flow," Chem. Eng. Progress 46, 258 (1950).

42. Lobo, W. E., Friend, L., Hashmell, R., and Zenz, F. A., "Limiting Capacity of Dumped Tower Packings," Trans. Am. Inst. of Chem. Engrs. 41, 693 (1945).
43. Mayo, F., Hunter, T. G., and Nash, A. W., "Wetted Surface in Ring-packed Towers," J. Soc. Chem. Ind. 54, 375 T (1935).
44. McCollaugh, R. and Gittings, L. D., "A Pilot Plant Fractionating Column," Ind. Eng. Chem. 22, 584 (1930).
45. McMahon, H. O., "Efficient Packing for Rectifying Columns," Ind. Eng. Chem. 39, 712 (1947).
46. Minard, G. W., Koffolt, J. H. and Withrow, J. R., "Fibrous Glass as a Packing Material for Packed Column Distillation," Trans. Am. Inst. Chem. Engrs. 39, 813-852 (1943).
47. Molstad, M. C., Abbey, R. G., Thompson, A. R. and McKinney, J. F., "Performance of Drip-Point Grid Tower Packing I and II," Trans. Am. Inst. Chem. Engrs. 38, 387-434, 885 (1942).
48. Molstad, M. C., McKinney, J. R., and Abbey, R. B., "Performance of Drip-Point Grid Tower Packing III," Trans. Am. Inst. Chem. Engrs. 39, 605-662 (1943).
49. Molstad, M. G. and Parsly, L. F., Jr., "Performance of Drip-Point Grid Tower Packings," Chem. Eng. Progress, 46, 26-28 (1950).
50. Parsly, L. F., Jr., Molstad, M. C., Cress, H and Bauer, L. G., "Performance of Drip-Point Grid Tower Packings," Chem. Eng. Prog. 46, 17-19 (1950).
51. Peck, R. E. and Wagner, E. F., "Film Resistances in Rectification," Trans. Am. Inst. Chem. Engrs. 41, 737-754 (1945).
52. Peters, W. A., Jr., "The Efficiency and Capacity of Fractionating Columns," Ind. Eng. Chem. 14, 476 (1922).
53. Perry, J. H., "Chemical Engineer's Handbook," McGraw-Hill Book Co., New York, 2nd Ed. (1941); 3rd Ed. (1950).
54. Piret, E. L., Mann, C. A. and Wall, T., Jr., "Pressure Drop and Liquid Holdup in a Packed Tower," Ind. Eng. Chem. 32, 861-863 (1940).
55. Reed, T. M., III and Fenske, M. R., "Hydrodynamics of Liquid-Vapor Flow in Packed Distillation Columns," Ind. Eng. Chem. 42, 654-659 (1950).
56. Robinson, C. S. and Gilliland, E. R., "The Elements of Fractional Distillation," McGraw-Hill Book Co., Inc., New York, Pp. 125-131, 218-225 (1939).
57. Sarchet, B. R., "Flooding Velocities in Packed Towers," Trans. Am. Inst. Chem. Engrs. 37, 283-304 (1942).
58. Scheibel, E. G. and Othmer, D. F., "A General Method for Calculating Diffusional Operations Such as Extraction, Distillation, and Gas Absorption," Trans. Am. Inst. Chem. Engrs. 38, 339-364, 883 (1942)
59. Schoenborn, E. M. and Daugherty, W. J., "Pressure Drop and Flooding Velocity in Packed Towers with Viscous Liquids," Trans. Am. Inst. Chem. Engrs. 40, 51-78, 389-407 (1944).
60. Schoenborn, E. M., Koffolt, J. H., and Withrow, J. R., "Rectincation in the Presence of an Insoluble Component," Trans. Am. Inst. Chem. Engrs. 37, 997-1022 (1941).
61. Scofield, R. C., "Industrial Fractionating Tower Packing," Presented at Nat'l Meeting of A.I.Ch.E., Pittsburgh, December 1949.
62. Scott, A. H., "Liquid Distribution in Packed Towers," Trans. Inst. Chem. Engrs. (London) 13, 211 (1935).
63. Sherwood, T. K., "Absorption and Extraction," McGraw-Hill, New York (1937).
64. Sherwood, T. K. and Gilliland, E. R., "Diffusion of Vapors Through Gas Films," Ind. Eng. Chem. 26, 1093 (1934).
65. Sherwood, T. K. and Holloway, F.A.L., "Experimental Studies of Absorption and Description," Trans. Am. Inst. Chem. Engrs. 36, 21-38 (1940).
66. Sherwood, T. K. and Holloway, F.A.L., "Liquid Film Data for Several Packings," Trans. Am. Inst. Chem. Engrs. 36, 39-70, 181 (1940).
67. Simon, M. J. & Rau., M. A. Govinda, "Method for Designing Packed Columns," Ind. Eng. Chem. 40, 93-95 (1948).
68. Smoker, E. H., "A High Efficiency Multi-Tubular-Packed Column," Trans. Am. Inst. Chem. Engrs. 40, 105-116 (1944).
69. Stedman, D. F., "Fractionating Columns of High Efficiency," Trans. Am. Inst. of Chem. Engrs. 33, 153 (1937).
70. Struck, R. T. & Kinney, C. R., "Efficiency of Packed Fractionation Columns," Ind. Eng. Chem. 42, 77-82 (1950).
71. Surosky, A. E. and Dodge, B. F., "Effect of Diffusivity on Gas-Film Absorption Coefficients in Packed Towers," Ind. Eng. Chem. 42, 1112-1119 (1950).
72. Surowiec, A. J. and Furnas, C. C., "Distillation in a Wetted-Wall Tower," Trans. Am. Inst. Chem. Engrs. 38, 53-90 (1942).
73. Taecker, R. G. and Hougen, O. A., "Heat and Mass Transfer of the Gas Film in the Flow of Gases Through Commercial Tower Packings," Chem. Eng. Progress, 45, 188 (1949).
74. Tour, R. S. and Lerman, F., "The Unconfined Distribution of Liquid in Tower Packing," Trans. Am. Inst. Chem. Engrs. 35, 719 (1939); 36, 177 (1940).
75. Tour, R. S. and Lerman, F., "Area Source Liquid Distribution Through Unconfined Tower Packing," Trans. Am. Inst. Chem. Engrs. 40, 79-104 (1944).
76. Underwood, A. J. V., "Fractional Distillation of Multicomponent Mixtures," Ind. Eng. Chem. 41, 2844-2846 (1949).
77. Weedman, J. A. and Dodge, B. F., Liquid Air Rectification in Packed Column," Ind. Eng. Chem. 39, 732 (1947).
78. Weisman, J. and Bonilla, C. F., "Liquid-Gas Interfacial Area in Packed Columns," Ind. Eng. Chem. 42, 1099-1104 (1950).
79. Westhaver, J. W., Theory of Open-Tube Distillation Columns," Ind. Eng. Chem. 34, 126-130 (1942).
80. White, G. E., "Graphical Construction of Transfer Units in Packed Towers," Trans. Am. Inst. Chem. Engrs. 36, 359-370 (1940).
81. White, G. E., "Method and Chart for Number of Transfer Units in Diffusional Operations," Chem. Eng. Progress 46, 363-368 (1950).
82. Wilke, C. R., "Estimation of Liquid Diffusion Coefficients," Chem. Eng. Prog. 45, 218 (1949).
83. Wilke, C. R., "Diffusional Properties of Multicomponent Gases," Chem. Eng. Progress, 46, 95-104 (1950).
84. Whitman, W. G., "The Two-Film Theory of Gas Absorption," Chem. Met. Eng. 29, 146, (1923).
85. Yu, K. T. and Coull, J., "Evaluation of Equilibrium Stages and Transfer Units," Chem. Eng. Progress 46, 89-94 (1950).
86. Zenz, F. A., "Mechanism of Countercurrent Gas-Liquid Flow Through Packed Towers," Chem. Eng. Prog. 43, 415-428 (1947).



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Performances of Floating Roofs

Q Many years ago you good people were kind enough to help me out on a floating roof problem and once again I have to impose on your goodselves for assistance, which I thank you for in anticipation:

Total floating weight of roof, 3000 lb
Roof floats on gasoline of 55 API gravity
Inside diameter of tank is 15 ft 0 in.
Annular space between shell and rim is 6 in.
How many inches will roof lower into liquid?
How many inches does liquid rise in annular space?
The above is just an example, but in general way I can apply the solution to larger sized tanks.

C. M. L.

A There are now several types of floating roof. The type C. M. L. has in mind is no doubt the Pan type. This type normally has a 6-in. downward pitch of the deck from the rim.

The calculations for submersion are as follows:

S G of oil equals .7568 equals 47.3 lb/cu ft

Volume required to float — weight of roof/47.3 lb $\frac{3000}{47.3 \text{ lb}}$ — 63.5 cu ft

Volume of cone equals 154 sq ft $\times \frac{0.5 \text{ ft}}{3}$ — 25.6 cu ft

Required volume to float.....63.5 cu ft
Volume of cone.....25.6 cu ft
Volume of cylinder.....37.9 cu ft

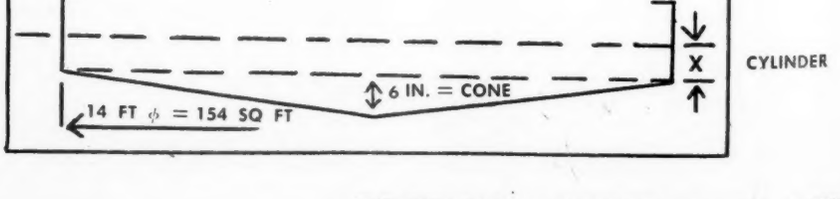
Depth of cylinder = X.

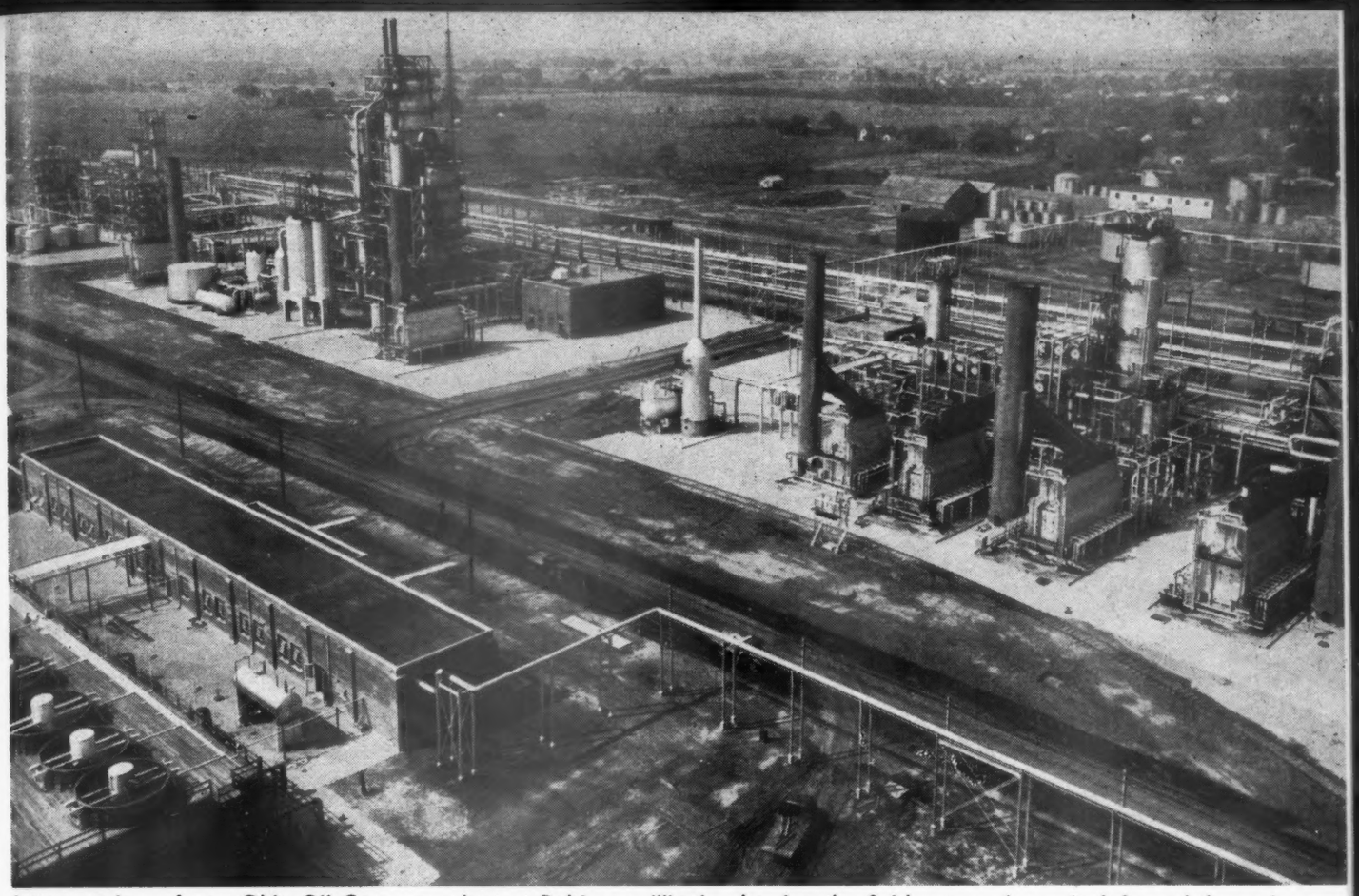
Then 154 X = 37.9 and X = 0.246 ft = 2.95 in.

In small roofs there is practically no deviation from the above, but on large roofs, say 60 ft diam. and up, the deck will bulge up slightly from a true cone and hence the height X of the oil at the rim will be very slightly more. For all practical purposes the above method is generally accurate enough.

The bulging effect of above mentioned varies for different sized roofs and for different roofs of the same size, so that to get a great accuracy. field measurements would be required.

J. H. Wiggins.





Jet's-eye view of new Ohio Oil Company plant at Robinson, Illinois, showing the fluid cat cracker unit, left, and thermal cracking and topping units, right.

P 721.33

Modernized Refinery Keeps Pace With Technology

ARCH L. FOSTER*

OHIO Oil Company's modernization program, which was begun in 1947, was preceded by a study of product requirements and processes that were most advantageous and efficient for making post war products. The main units installed include an atmospheric vacuum crude distillation unit of 27,500 bbl per stream day capacity; a fluid catalytic cracking unit of 12,400 bbl per day capacity; gas concentration and polymerization units to handle the increased gas production of the refinery; expansion of the steam production facilities; waste oil recovery, water cooling capacity, and other units auxiliary to the main processing capacity of the plant.

The general design and equipment used in the crude distillation unit incorporates the latest developments of the oil refining industry. The unit has a designed capacity of 27,500 bbl per stream day of Illinois crude oil from which the following approximate yields of products are obtained:

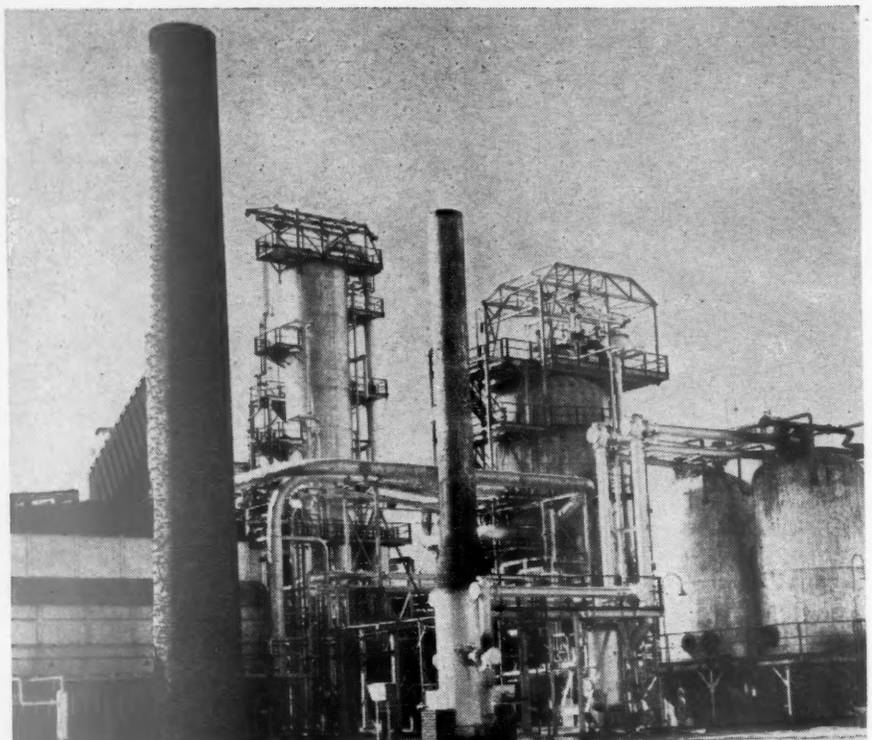
	Volume per cent	B/SD
Straight run gasoline (410 F E.P.)..	30	8,250
Kerosine	10	2,750
Diesel fuel oil	10	2,750
Gas oil	40	11,000
Asphalt	10	2,750

The crude oil, pumped from a refinery storage tank, is heated from atmospheric temperature to 260 F by exchanging heat with part of the hot products leaving the units and is then desalted by the Tretolite process. The desalter reduces the salt content from about 50-60 lb per 1000 bbl to only a few pounds. After the desalting process, the crude picks up additional heat exchange with the remaining hot products going to storage and is charged through two UOP updraft heaters in parallel. The crude is discharged from the heaters at a temperature of 600-610 F to the atmospheric column where gasoline, kerosine, diesel oil, and a gas oil fraction is removed.

Vapors from the top of the atmospheric crude distillation column are condensed as 410 F EP gasoline. The kerosine, diesel oil and gas oil fractions are removed as sidestreams. The reduced crude from the bottom of the column is pumped through a UOP updraft reduced crude heater and discharged at a temperature of about 775 F into the vacuum column, operating at about 20 mm Hg absolute pressure

*Refining and Gas Processing Editor.

EXCLUSIVE



Crude unit No. 2, in the asphalt oxidizing section of the refinery.

where vacuum gas oil is removed overhead. The vacuum column can be operated to produce a bottom asphalt product of 80-90 F mp or 102 F mp (180-200 penetration asphalt).

The bottoms asphalt product can be charged to the turbo-oxidizer for air blowing to 60/70 penetration asphalt. The turbo oxidizers are two vertical vessels operating in series with turbine type mixers to secure efficient air utilization. Air for oxidation is supplied by a positive displacement type blower. Vapors from the turbo oxidizers are disposed of by burning in a brick-lined steel stack.

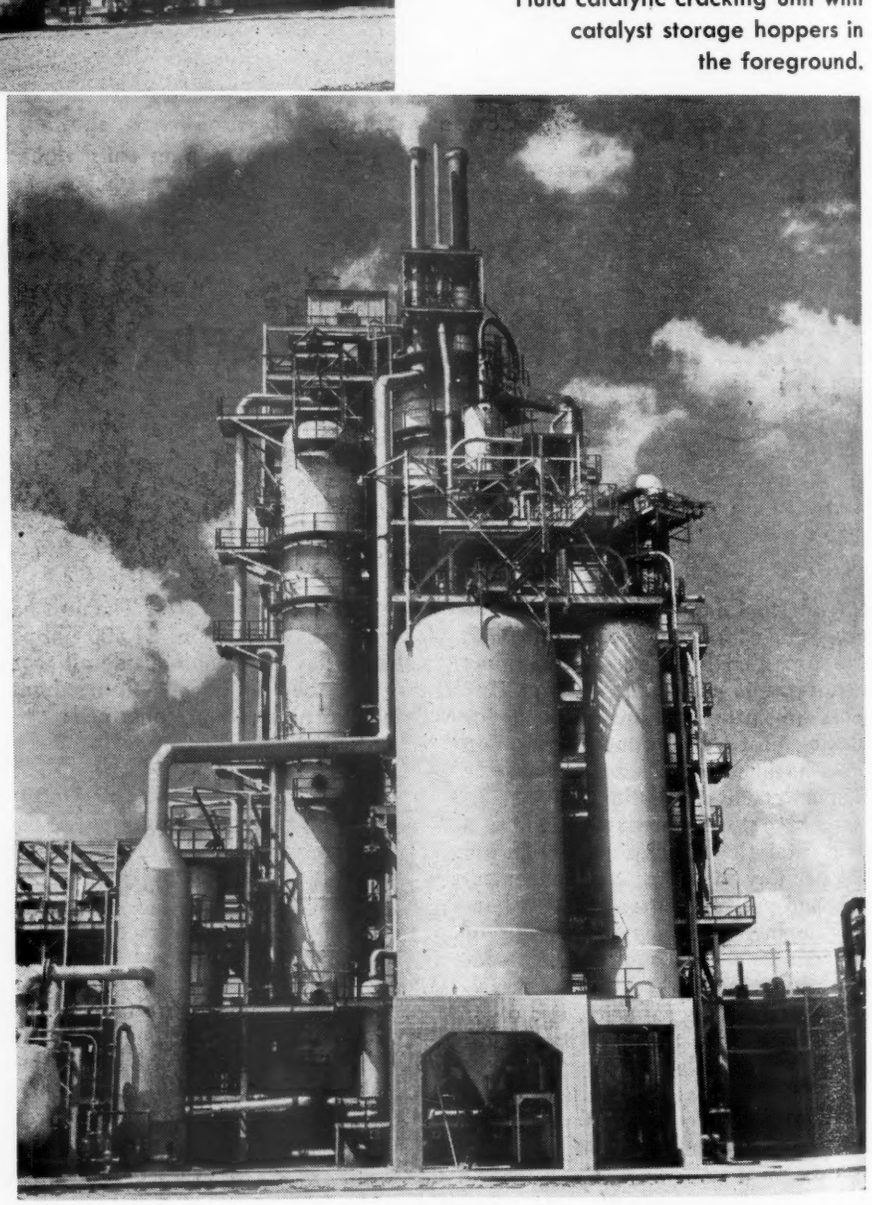
Facilities are available for fractioning at 410 F EP straight run gasoline into a light straight run fraction having an end point of 300 F and a heavy normal naphtha. The light straight run gasoline is blended into finished gasoline and the heavy naphtha can be reformed to increase its octane number.

Fluid Catalytic Unit

The gas oil charge to the catalytic cracking unit consists of the vacuum and atmospheric gas oils. Diesel oil may also be blended into the charge to the catalytic unit or may be sold for diesel consumption. The gas oil charged is pumped from storage to a surge drum from which it is pumped to the catalytic unit preheater, which is used only when necessary to maintain the unit in heat balance. The preheated charge meets the catalyst at a temperature of about 1080 F at the base of the reactor riser where the oil is completely vaporized. The rate of flow of catalyst is controlled to supply the desired cracking temperature of 870-875 F. A level controller regulates the depth of the catalyst bed in the reactor. The pressure on the reactor is approximately 10 psig and on the regenerator about 19-20 psig. The flow in the catalytic cracking unit is shown in Fig. 2.

The differential pressure between the reactor and regenerator is maintained by valves on the flue gas outlet. Steam admission into the riser is provided for, in case of a stoppage of the charge vapors, to keep catalyst moving and prevent plugging of the riser.

In the regenerator there are three



Fluid catalytic cracking unit with catalyst storage hoppers in the foreground.

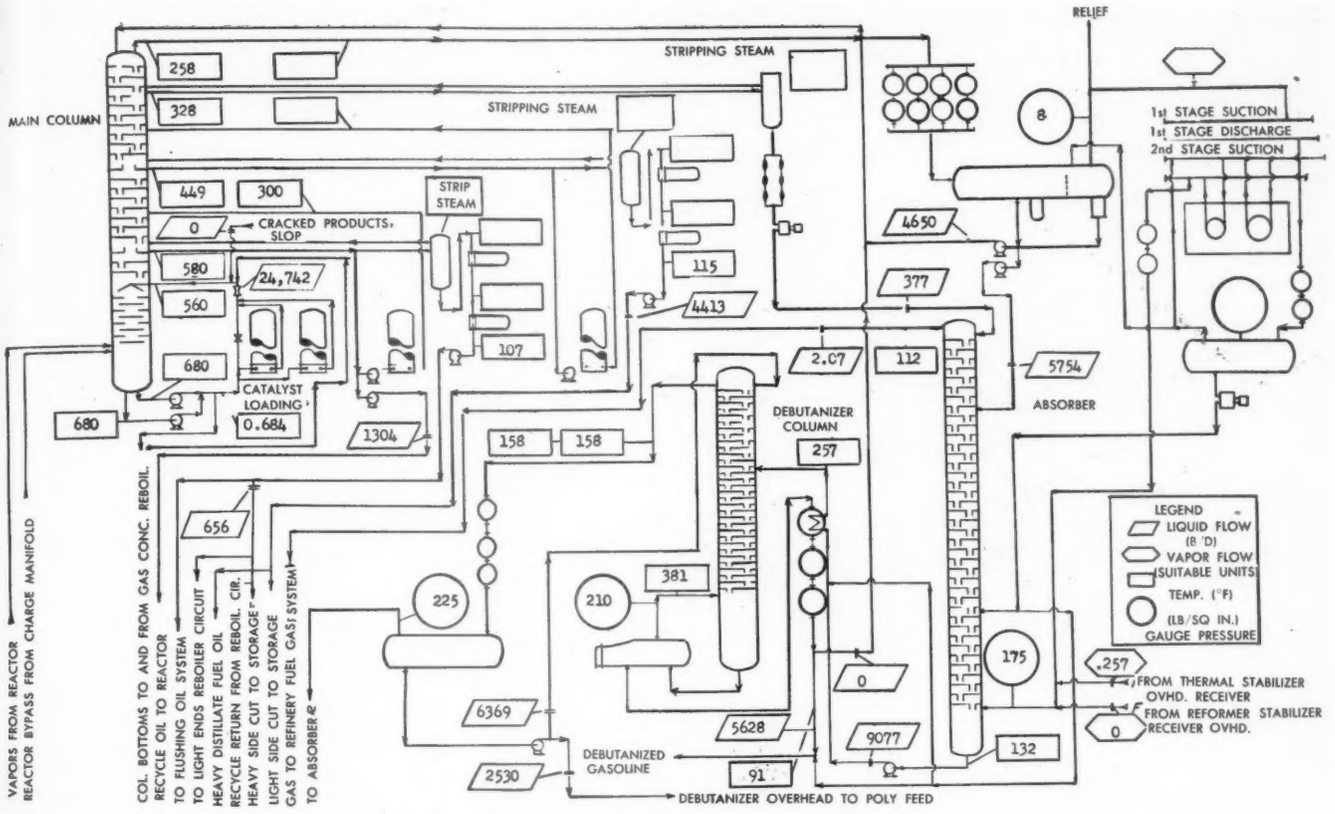
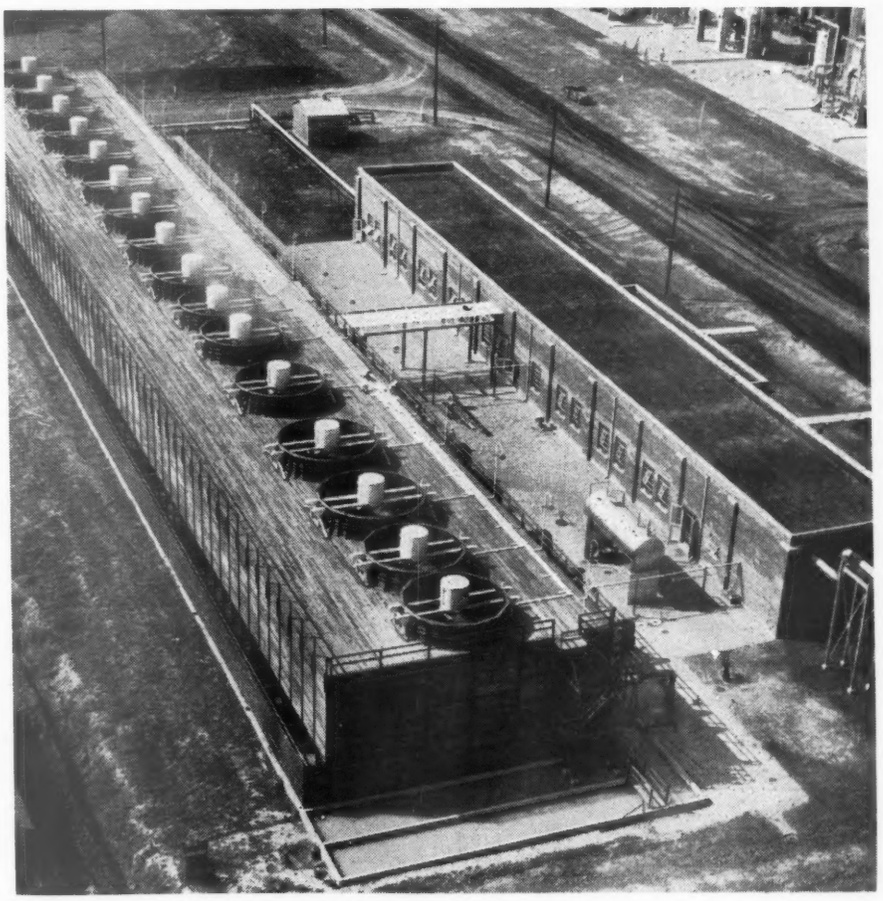


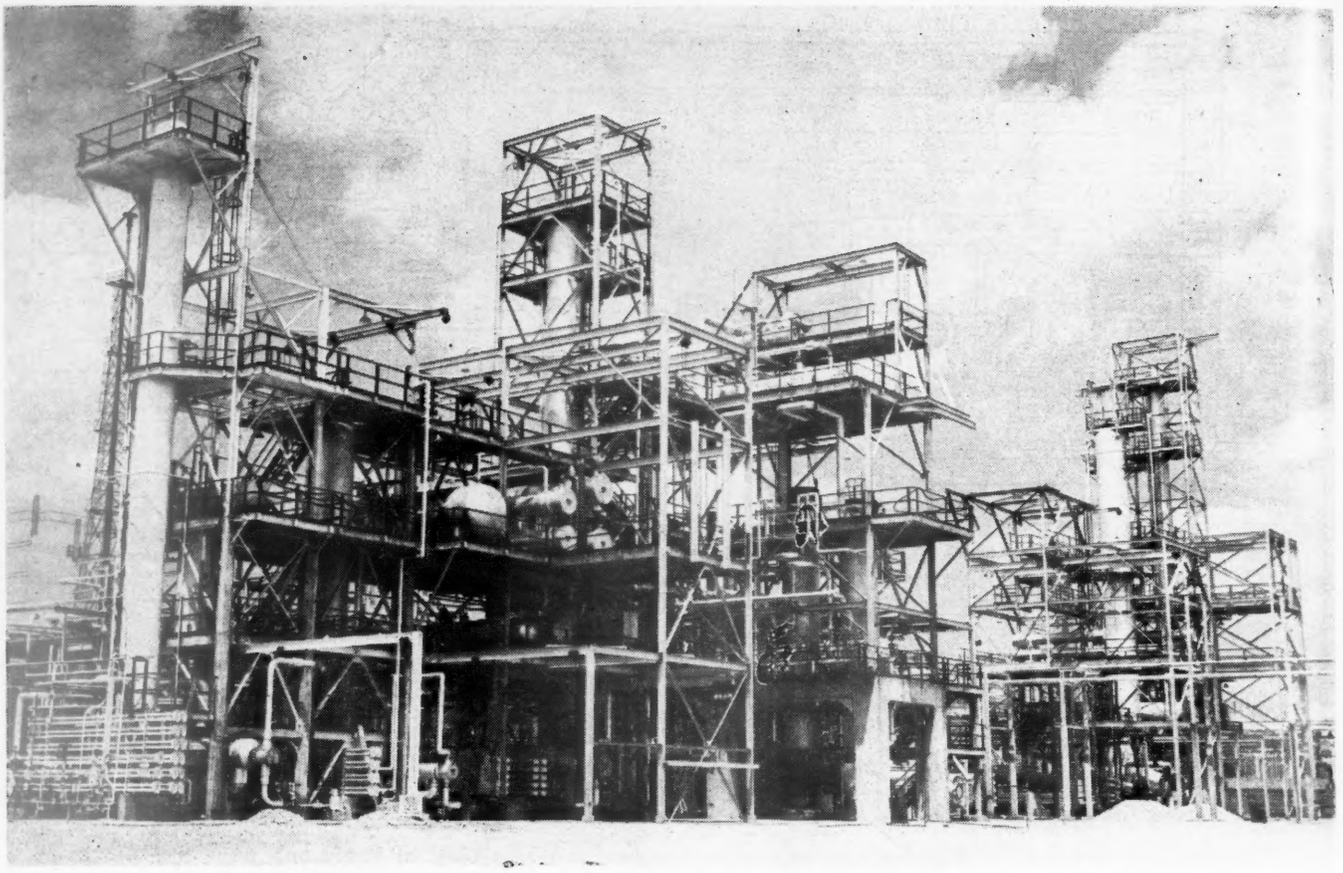
FIG. 1. Fractionation layout for catalytic cracking unit, at Robinson.

stages of Buell cyclones with four parallel units in each stage, or 12 cyclones in all. Three one-stage cyclones are employed in the top of the reactor. To stop after-burning in the upper portion of the regenerator four National Air Oil quench nozzles are provided at about cyclone level and three similar nozzles in the regenerator dome, through which quench water is injected. Two torch nozzles of the same make are installed just below the lowest grid in the regenerator catalyst bed for providing the necessary heat on a start-up or for emergency conditions when a Peabody air heater is also used on a start-up.

The catalyst from the reactor passes through an external stripper and then into the regenerator where the carbon is burned off. Present practice is to hold the residual carbon on the regenerated catalyst to not more than about 0.40 per cent. The flue gas from the top of the regenerator passes through a steam generator at a temperature of about 1050 F, then through control valves, then an expansion chamber where three perforated grid plates permits reduction in pressure to about 1-2 psig and finally through a Burgess-Manning silencer to the atmosphere. The control valve is provided with a by-pass arrangement to be used when necessary. The steam generator makes



Cooling towers, with 16 fans, and water distribution pump house.



Reactors and LPG Column, at extreme left, south end of light-ends area.

about 21,000 lb of 150 psig steam per hour by utilizing the heat in the flue gas.

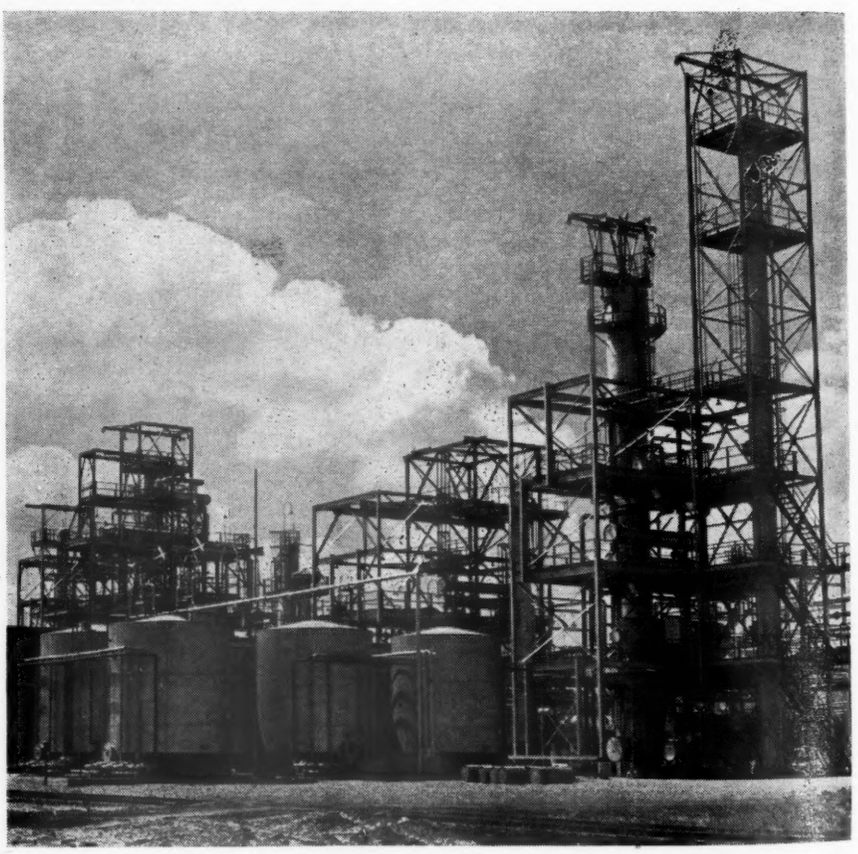
The vapors from the reactor pass to the main fractionator column that contains 19 bubble trays in the upper section and 9 discs and do-nut baffles in the lower section of the tower. The gasoline vapors from this tower are condensed in four pairs of condensers in parallel and pass on into the overhead receiver drum. The unstabilized catalytic cracked gasoline is pumped to the absorber in the light ends area where it serves as the absorbing medium in the absorber and is then debutanized.

The gas from the overhead receiver is compressed to 175 psig by Clark, two-cycle, 500 hp, compressors and discharged after passing through after-coolers to the bottom of the absorber.

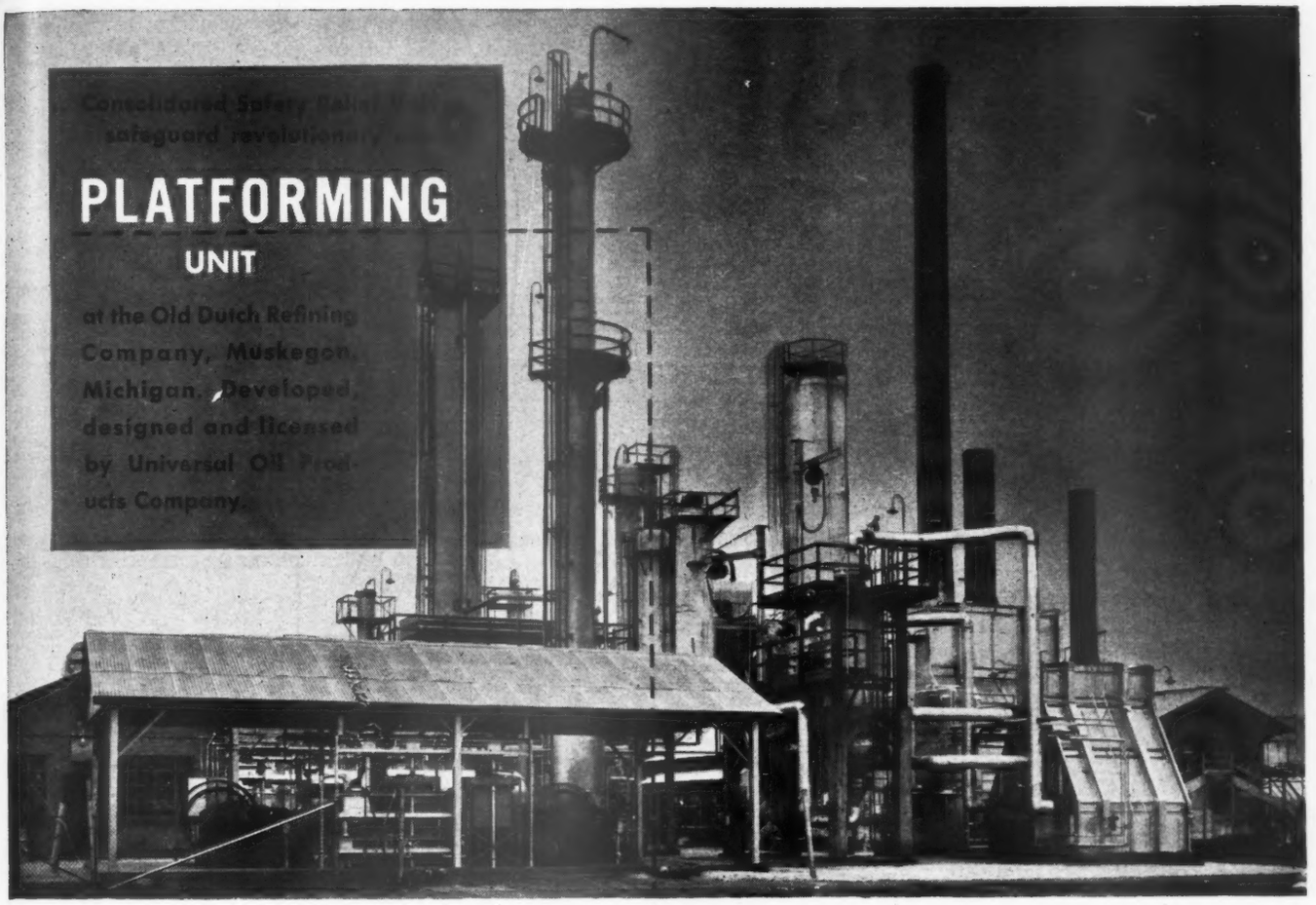
A heavy naphtha sidecut is with-

TABLE 1. Properties of Illinois crude processed by Ohio Oil Company's Robinson refinery.

Inspection;	
Gravity, API, deg.	35.9
B. S. and W., vol. per cent	0.3
Sulfur, wt. per cent	0.2
Color	black
Cold test, deg F	(-20)
Reid vap. pres. psia	2
NaCl, lb/1000 bbl	60.



Caustic tanks in foreground; catalyst absorber and debutanizer at right, with the polymerizer unit the background.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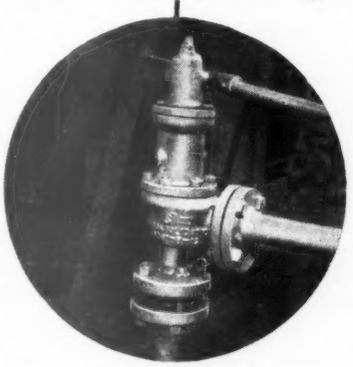
Consolidated Safety Relief Valves were selected to do the job. For Consolidated outside bevel seat and floating guide construction positively eliminates leakage under *discharge piping stresses*. Only Consolidated Safety Relief Valves have that all-important and exclusive extra safeguard of *built-in fixed capacity* . . . independent at all times of the position of multiple adjustable blow-down rings. One adjustment controls blow-down . . . cannot be altered accidentally during maintenance . . . lift or secondary annual orifice area is not disturbed.



This is one of the many Consolidated Safety Relief Valves installed throughout the new Platforming Unit of the Old Dutch Refining Company.

The basically simple design (25% of the parts used in ordinary safety valves are eliminated), assures much lower maintenance costs and also minimizes standardization problems.

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C/O	3.79
WHSV	
Circulation Rate Tons/Min.	18.3
C/O Combined Feed	11.6
W.H.S.V. Combined Feed	3.05
Combined Feed Ratio	1.185
Catalyst Carbon Level	
Spent Wt. %	
Regenerated Wt. %	0.305
Catalyst Activity	
U.O.P. Rating (Date)	8-2-49
Wt.	25
Vol.	38
A.B.D.	.75
Flue Gas	
CO_2/CO Ratio	1.38
Carbon Burned #/Hr.	11,666
H_2 by O_2 Disappear #/Hr.	1,217
Total Catalyst Deposit #/Hr.	12,883
H_2 Wt. % of Catalyst Deposit	9.45

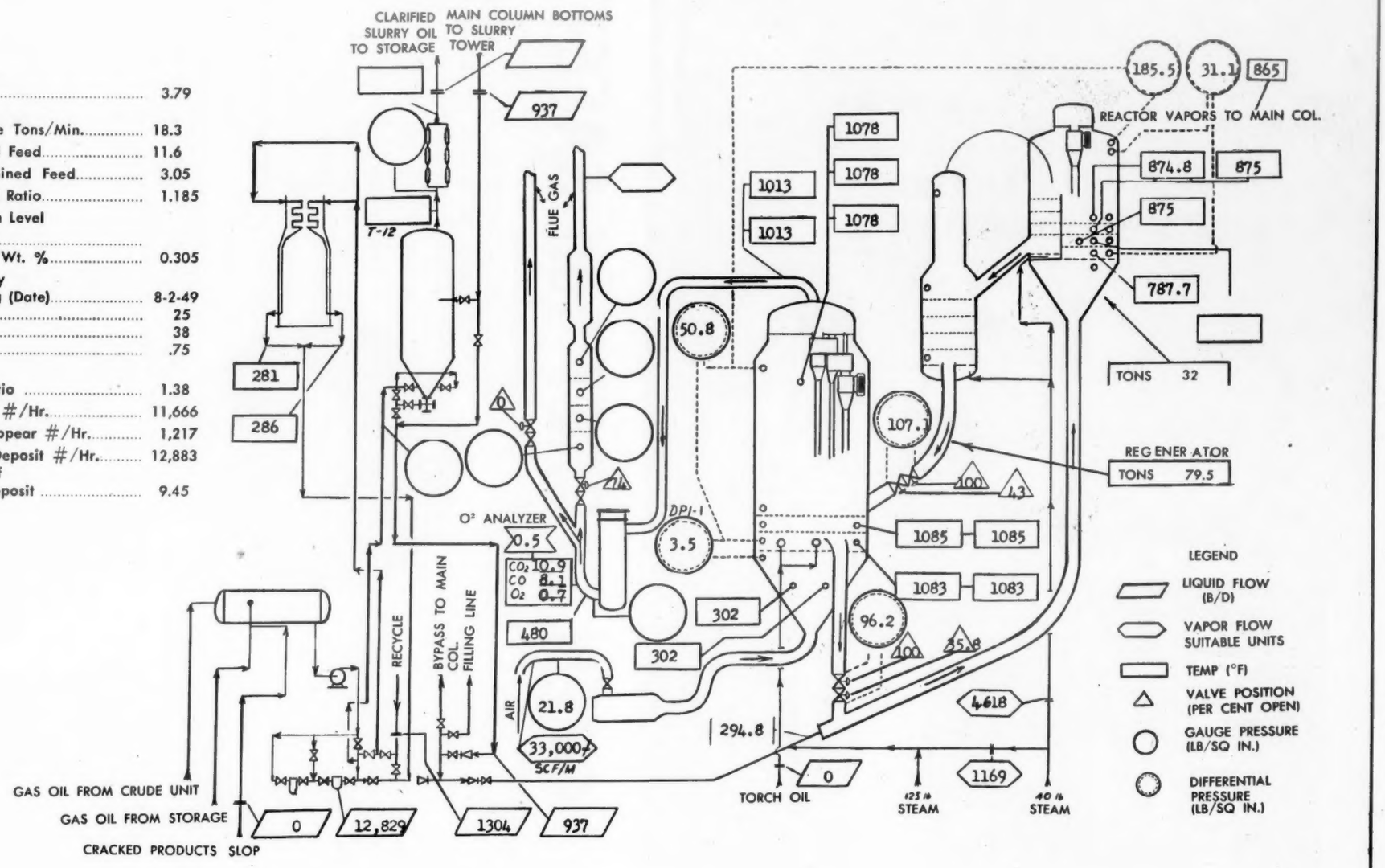


FIG. 2. Flow in catalyst section of fluid catalytic cracking unit.

TABLE 2. Weekly summary of catalytic cracking operations.

Conversion 56.5 volume per cent

	bbl/day	vol. per cent charge		lb/hr	weight per cent
Raw charge	13,389	.....	Carbon	10,145	90.9
Slop oil	106	.....	Hydrogen	1,019	9.1
Catalytic C_3–$C_4$5	1,630	12.2	Catalyst deposit	11,164	100.0
Catalytic gasoline	5,723	42.7	Recycle rate	BID	1,534.
Lt. side cut	3,349	25.0	Slurry return to reactor	BID	720.
Heavy side cut	2,181	16.4	Total recycle	BID	2,254.
Clarified slurry	275	2.1	.....	.....	.....
Recovery, liquid volume per cent	.....	98.4	.....	.....	.....
Total absorber lean gas MM/day	.....	2.576	.....	.....	.....

Reactor		Regenerator	
Dense phase temp., F	875.	Dense phase temp., F	1,071.
Differential press, in./H_2O	180.	Pressure, psig	19.2
Combined feed temp., F	370.	Catalyst holdup, tons	82.5
Catalyst holdup, tons	26.5	Blower air, SCF/min	28,074.
Catalyst circ. rate, T/min	19.0	Blower discharge pressure, psig	21.6
Fractionator bottoms to slurry settler BID	992.	Wt. per cent con regen. catalyst	0.361
Strip steam, lb/M lb cat. circ	2.12	Flue gas: CO_2=11.1; CO=7.9; CO_2/CO =1.41; O_2=0.5	.....
Injection steam, lb/hr	2,537.		
W.H.S.V. on combination feed	3.85		
C/O ratio on combination feed	11.7		
Severity factor	3.04		

TABLE 3. Inspection on feed and products for catalytic cracking unit operation.

	Raw oil	Lt. gasoline	Naphtha	L.S.C.	H.S.C.	Debut. gasoline	Fract. bottoms
Grav. API	27.8	58.0	33.9	28.6	26.2	.....	13.3
Pour	.....	.....	.....	.....	+60	7.66 RVP	....
Flash	.....	.....	.....	19.7	258	.....	....
IBP	.....	.....	224	408	411	94.	....
10 per cent	.....	.....	363	477	603	135.	....
50	.....	.....	.....	.....	.....	233.	....
90	.....	374.	430.	576.	720.	383.	....
EP	.....	403.	470.	617.	751.	427.	....
B.S.W., per cent	.....	.....	.....	.....	.....	.....	1.1
Per cent (a) 650	28.	.....	.....	.....	.....	.....	....
Carbon	0.344	.....	.....	.....	.....	.....	....

TABLE 4. Podbielniak analyses of poly unit feed gas.

	Thermal poly feed		Cat. Poly feed		Combined poly feed	
	Mol. per cent	liq. vol. per cent	Mol. per cent	liq. vol. per cent	Mol. per cent	liq. vol. per cent
CH_4	1.07	0.59	.....	.....	1.29	0.79
C_2H_4	1.40	1.18	0.57	0.42	1.29	0.97
C_2H_6	13.12	11.78	3.81	3.34	6.19	5.47
C_3H_6	12.50	11.63	24.70	22.38	22.75	20.92
C_3H_8	27.07	26.07	10.20	9.59	14.49	13.86
i-C_4H_{10}	5.83	6.63	22.27	24.95	17.94	20.39
i-C_4H_8	7.51	7.81	10.88	11.05	9.41	9.71
l-C_4H_8	8.91	9.28	14.72	14.94	9.28	9.53
u-C_4H_{10}	18.83	20.77	4.36	4.73	6.43	7.06
2-C_4H_8	2.02	2.06	7.66	7.57	9.88	9.97
C_5 and heavier	1.74	2.20	0.83	1.03	1.05	1.33
Per cent Olefins (Calc.)	32.34		58.53		52.61	

drawn from the third tray from the top of the main fractionator tower and is discharged to the top of the absorber column where it serves as sponge oil.

Light and heavy gas oil sidestreams are also withdrawn from the column, which are either recycled to the reactor riser or discharged to storage.

Light recycle gas oil from the main fractionator column is recycled through a steam generator for the production of 40 psig steam. Heavy recycle gas oil is also recycled in a similar manner through an additional steam generator. These 2 steam generators produce about 25,000 lb per hr of 40 psig steam. About 50,000 lb per hr of 150 psig steam is produced from the main column bottoms and flue gas steam generators.

Total conversion in the catalytic operation is 56-57 per cent of the charge. For this operation the yield of gasoline is about 40-42 per cent. About 1500 bbl per day of light and heavy recycle gas oils are recycled back to the reactor riser together with approximately 700 bbl per stream day of slurry oil.

Typical results and operating conditions from a weekly operating summary are shown in Table 2. This table contains a large portion of the essential information needed to summarize thoroughly the operation of the unit.

Polymerization Unit

The C_3-C_4 fraction from the catalytic gasoline debutanizer pass through a Girbotol unit for removal of hydrogen sulfide and then charged to the UOP polymerization unit. The reactors in this unit operate at a pressure of about 1000 psig and at a temperature of 400-410 F. Approximately 1000 bbl per stream day of polymer gasoline of 2 lb Reid vapor pressure is made from a total feed of 2200-2300 bbl per stream day. A C_4 cut is recycled so the olefin content of the charge is about 40 per cent. By this procedure it is felt that longer catalyst life is obtained than when operating on a feed of 50 per cent or over of olefins. Water is injected into the feed to the unit by a Hills-McCanna chemical proportioning pump to maintain the catalyst in the proper state of hydration. Sufficient water is injected to maintain 0.15 mol. per cent water in the feed.

Table 3 shows the average composition of the various streams to the feed for the polymerization unit and the composition of the charge before the addition of the recycle C_4 fraction.

The gasoline inhibitor system employs three Toledo scales, one for the catalytic cracked gasoline, one for the polymer gasoline and one for the inhibitor mixing drum to record the amount of inhibitor injected. The inhibitor is injected continuously in proportion to the amount of gasoline being processed by means of Proportioneers injectors controlled from Smith Meters. A standby remote control unit is also provided for use if trouble is experienced with the meters.

Heat for the reboilers in the light ends area, which includes the debutanizers and polymerization unit, is provided by hot circulating gas oil which is heated to a temperature of 600 F in a UOP updraft heater. This heated oil passes through a general piping system to seven reboilers, is collected by a header into a surge drum at 400 F and is pumped from the surge drum back to the heater. The oil used is heavy catalytic recycle gas oil.

Choice of Materials for Service

Some of the materials selected for special service in the design of the plant are of interest. For instance, the top 15 ft of the crude fractionator column is lined with monel metal to combat corrosion from HCl, which may be obtained by a breakdown of the salts remaining in the crude after the desalter unit. Similarly, the catalytic unit fractionator is lined for a distance of 11 ft at its top with monel metal.

The reactor in the catalytic unit is lined with 11-12 per cent chrome to withstand the very severe corrosion and erosion that is possible in this vessel.

The cyclones in the reactor are of carbon steel.

The catalyst regenerator is lined with Lumnite-Vermiculite lining 3½ in. thick. This lining is protected from erosion by the catalyst by a ¾ in. of refractory castable set in Hexsteel grating. The regenerator cyclones are stainless steel.

The reactor riser has a carbon steel liner for a distance of 14 ft above the catalyst inlet to resist corrosion and erosion of this line after the injection point.

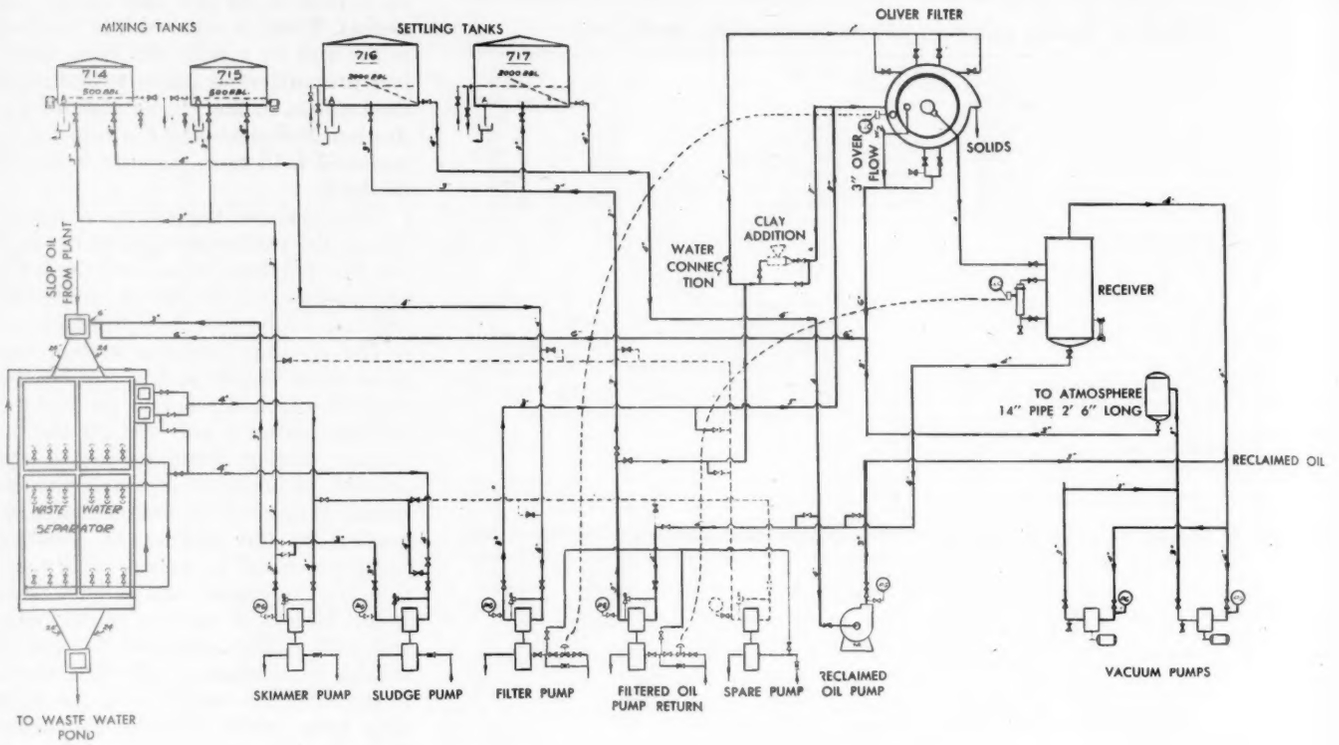
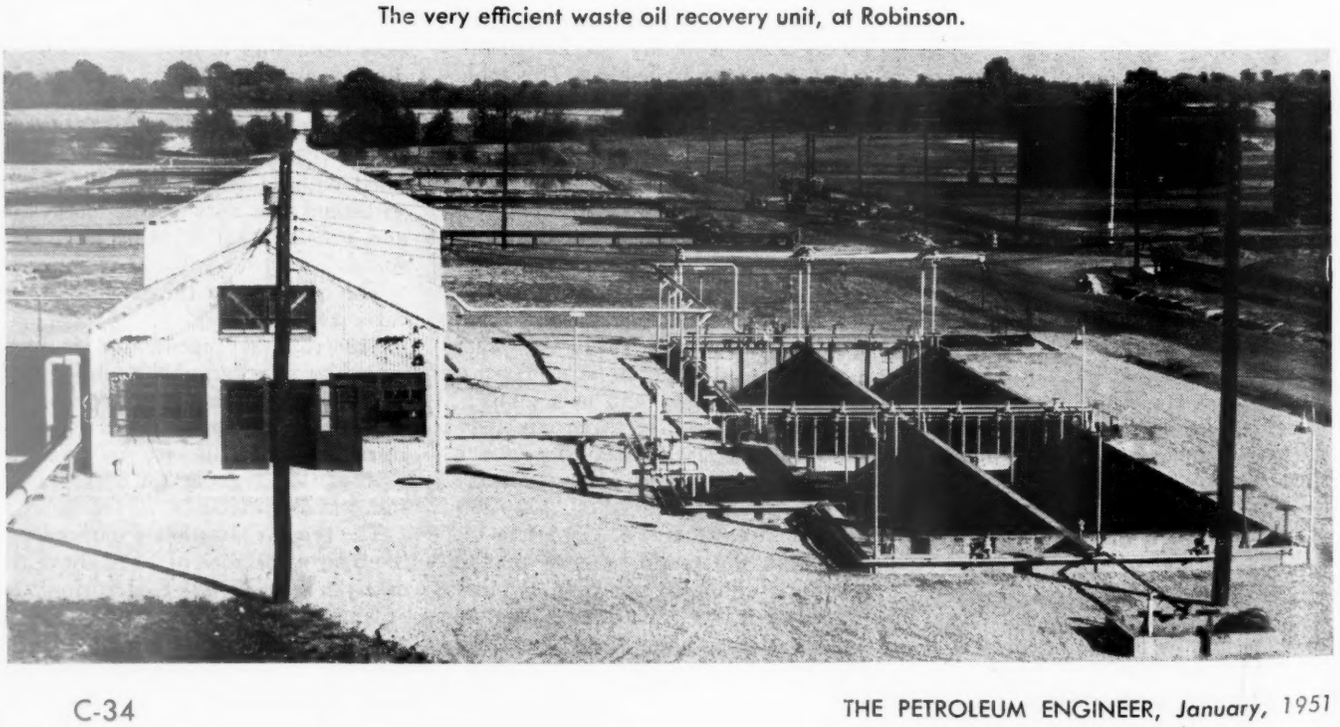


FIG. 3. Flow chart of waste oil recovery unit operation.

Slop Oil Recovery Unit

Fig. 3 shows the flow for the slop oil recovery system, which has some unique and useful features worthy of note. The oil recovery in this unit ranges from 150 bbl per day to 800-900 bbl per day, depending on operations in the plant. Slop oil-water mixtures from all parts of the plant are collected in the sump shown at left in the chart, immediately about the 4 separators. The mixture is transferred to these separator tanks, where the supernatant oil is skimmed continuously off the top through drains to the small sumps at the upper right, where the skimmer pump takes suction and sends the oil to the 500 bbl mixing tanks. From these tanks the filter pump takes suction and pumps the oil to the Oliver Precoat filter. A slurry of filter clay is made up and predetermined amounts are added to the oil stream en route to the filter. Passing through the filter, the clay coagulates and collects the solids in the oil on the filter pad; as in the use of this filter for other purposes, the collected mass is shaved off the surface of the filter pad in a thin layer continuously and is dumped to waste. Oil from the filter is collected in a receiver, is pumped to settling tanks from which the reclaimed oil pump sends it to storage. The entire system is relatively simple. * * *

The very efficient waste oil recovery unit, at Robinson.



Method of Calculation for High Purity Fractionation

FRANK C. FOWLER

THE petroleum industry has continually increased the quality of their products. Several products are now manufactured in tank car quantities in purities exceeding 99 per cent. A fractionating column may be designed to produce either a bottom or overhead product of extremely high purity. Many of these separations involve binary mixtures. When the bottom product is desired in high purity, the concentration of the more volatile component must be reduced to a very low value. Examples of bottom products of high purity include the systems: Water-hydrocarbon, HF-butane, hydrocarbon-hydrocarbon, and alcohol-water. Design of fractionating columns for these systems can be facilitated by using a log-log plot of the McCabe-Thiele diagram. A discussion of the log-log plot for use in the low concentration range of the more volatile component has been presented by Fowler[2] and by Robinson and Gilliland.[3]

High Purity Overhead Products

The literature has not pointed out the possibility of extending the application of the log-log plot to the region of high concentrations of the more volatile component. It is possible to employ the log-log plot of the McCabe-Thiele Diagram in this region of high concentrations of the more volatile component by using the less volatile component in the calculations instead of the more volatile component.

As engineers have been accustomed to thinking of fractionation in terms of the more volatile component, they sometimes have difficulty in interpreting results from a log-log plot on basis of the less volatile component. After making a few calculations, problems can be interpreted on the basis of the less volatile component as readily as on the basis of the more volatile component.

The equilibrium curve will fall below the 45-degree line when the less volatile component is used in plotting the ordinate and abscissa. This is due to a value of α which is less than one. On the basis of the less volatile component α will always be less than one. The relative volatility, α, may be obtained from either vapor pressures according to Equation 1 or from equilibrium constants according to Equation 2.

$$\alpha = \frac{P_d}{P_c} \quad . \quad . \quad . \quad . \quad . \quad (1)$$

$$\alpha = \frac{K_d}{K_c} \quad . \quad . \quad . \quad . \quad . \quad (2)$$

In Equations 1 and 2 the subscripts c and d refer to the more volatile and less volatile components respectively.

The operating lines will also fall below the 45-degree line. It is important to remember that the lower operating line in the diagram will now correspond to the upper section of the fractionating column. This also means the lower operating line in the diagram will have a slope of less than one. In a normal McCabe-Thiele diagram the lower operating line has a slope greater than one and corresponds to the lower section of the column. This may cause some confusion the first time plots are drawn using the less volatile component.

Equations 3 and 4 represent the equations of the lower and upper operating lines on the log-log plot.

$$y_{n+1} = \frac{Lx_n}{V} + \frac{Dx_D}{V} \quad . \quad . \quad . \quad (3)$$

$$y_{m+1} = \frac{\bar{L}x_m}{\bar{V}} + \frac{Bx_B}{\bar{V}} \quad . \quad . \quad . \quad (4)$$

These equations of the operating lines are identical with the usual equations with the exception that y and x are mol fractions of the less volatile component instead of the more volatile component.

Operating lines appear curved in a log-log plot as illustrated by Fig. 1. For this reason it is necessary to determine several points on the operating lines before plotting them. After the equilibrium curve and operating lines have been drawn, the number of theoretical plates are stepped off in the usual manner.

A comparison of the number of theoretical plates at total reflux calculated from Fenske's Equation[1] and determined from a log-log plot offers a simple test of the accuracy of the log-log method. Results of such a comparison are given in Table 1 for several values of relative volatility, α, from 0.40 to 0.80 (based on less volatile component).

TABLE 1. Comparison of theoretical plates from log-log plot and Fenske's Equation.

Concentration Range.....	α=0.40		α=0.60		α=0.80	
x_F to x_D (mol % more volatile)..	Log-Log	Fenske	Log-Log	Fenske	Log-Log	Fenske
50 to 99.9.....	7.5	7.5	13.5	13.5	30.6	31.0
50 to 99.99.....	10.1	10.0	18.1	18.0	40.7	41.3
50 to 99.999.....	12.6	12.6	22.6	22.5	50.4	51.5

The log-log plots used in obtaining Table 1 were drawn on two 8½ by 11 sheets of 3 cycle log-log paper. Good results were found for α's of 0.40 and 0.60. A maximum error of 2.2 per cent in number of plates was found for the α of 0.80. This was expected as the equilibrium curve approaches the 45-degree line resulting in a large number of plates when α approaches one. This comparison indicates that good results should be attainable when 3 cycle log-log paper is used in the 8½ by 11 size. Comparable results on rectangular coordinates would require graph paper inconvenient to handle.

The Author

Frank C. Fowler, author of this article on High-Purity Fractionation, came into the oil industry via the chemical engineering department of Phillips Petroleum Company, at Bartlesville, Oklahoma, a path many others in the technical ranks of the industry have travelled. Fowler started his college education at the University of Illinois, taking the bachelor of science in chemical engineering in 1939. He transferred to the University of Michigan and received a master's degree in 1940, then was granted the PhD in chemical engineering in 1943. From that time to 1946 he operated as senior process engineer at Phillips, working on the designs of chemical and petroleum processing plants. He heard a call, then, to join the chemical engineering staff of Oklahoma University and has remained there since, as professor of chemical engineering.

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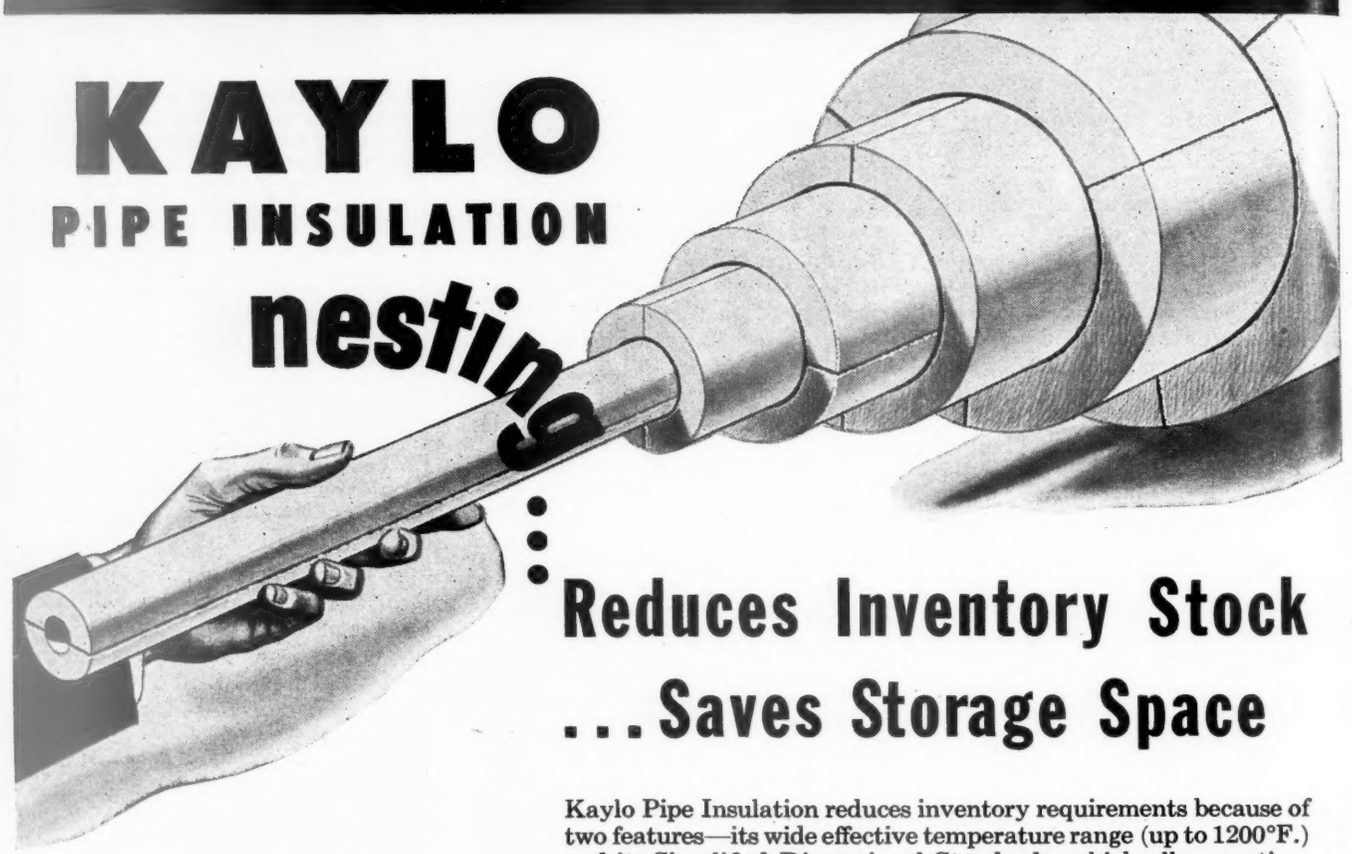

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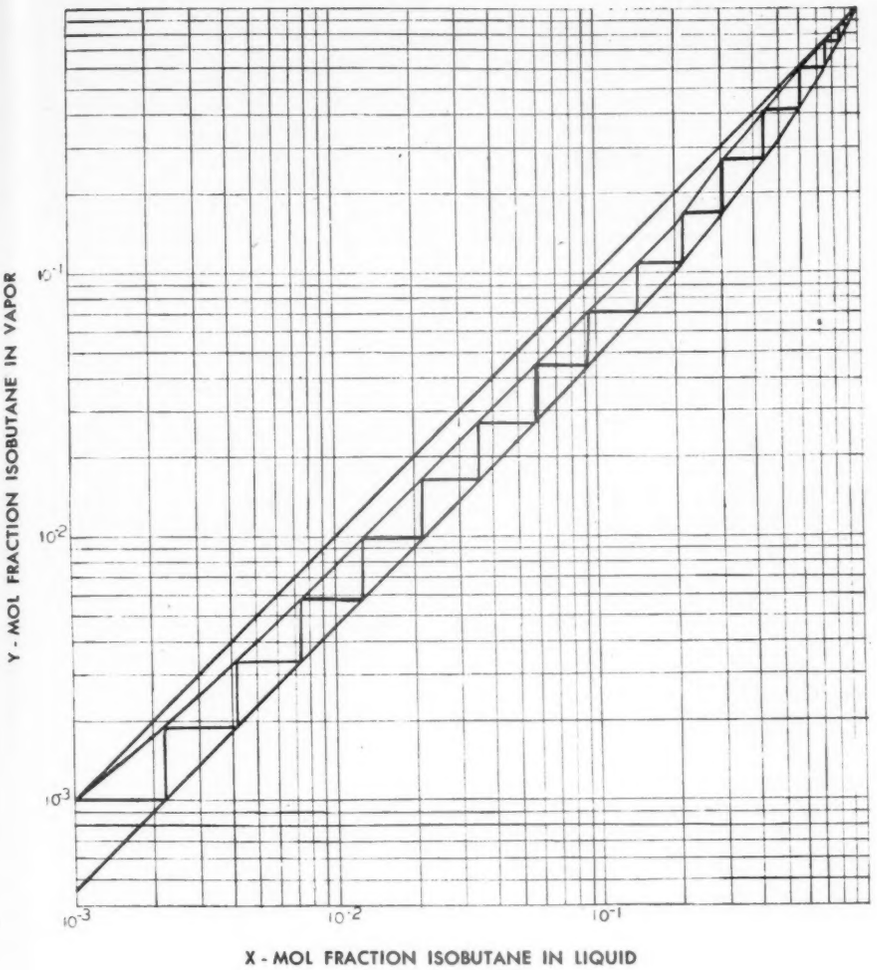

FIG. 1. Log-log plot of McCabe-Thiele diagram.

Illustration

A typical problem on fractionation of propane from isobutane should illustrate the method described.

Problem

Determine the number of theoretical plates required to produce propane of 99.9 mol per cent purity from a feed composed of 20 per cent propane and 80 per cent isobutane. Assume that the bottom composition will be 90 per cent isobutane. Use a reflux ratio which is 1.5 times the minimum L/V ratio. Cooling water is available which will permit operating the overhead condenser at a temperature of 110 F.

Solution

As the overhead product is so pure, the minimum column pressure will correspond to the vapor pressure of propane which is 215 psia at 110 F.

Equilibrium constants at 110 F and 215 psia for propane and isobutane give an α of 0.45 according to Equation 2. Points on the equilibrium curve can be calculated from the familiar equation.

$$y = \frac{\alpha x}{(\alpha - 1)x + 1} \quad . \quad . \quad (5)$$

The minimum reflux can be determined from the overhead composition and the intersection of the feed and operating line on the equilibrium curve.

	x	y
Overhead Product	0.001	0.001
Intersection of Feed	0.200	0.100

$$\text{Min L/V} = \frac{0.100 - 0.001}{0.200 - 0.001} = 0.50$$

$$\text{Actual L/V} = 1.5\ (0.50) = 0.75$$

Equation of operating line in upper section of column

$$y = 0.75x + \frac{Dx_D}{V}$$

Using the composition of the overhead $x_D = y_D$

$$0.001 = 0.00075 + \frac{Dx_D}{V}$$

$$\frac{Dx_D}{V} = 0.00025$$

Equation of operating line in upper section is

$$y = 0.75x + 0.00025 \quad . \quad . \quad . \quad (6)$$

The y coordinate on the operating line for the lower section at the feed composition $x_F = 0.20$ is found from Equation 6

$$y = 0.150$$

Therefore

$$L/V = \frac{0.90 - 0.15}{0.90 - 0.20} = 1.072$$

The equation of the operating line in the lower section is

$$y = 1.072x - 0.0648 \quad . \quad . \quad . \quad (7)$$

Several points were determined from Equations 6 and 7 in order to plot the operating lines in Fig. 1. Stepping off plates in the usual manner shows that 15½ theoretical plates are required to produce propane of 99.9 mol per cent purity.

Nomenclature

B = mols of bottom product
D = mols of overheated product
K_d = vapor-liquid equilibrium constant of less volatile component
K_c = vapor-liquid equilibrium constant of more volatile component
L = mols of liquid from plate n in rectifying section
$\bar{L}$ = mols of liquid from plate m in stripping section
P_d = vapor pressure of less volatile component
P_c = vapor pressure of more volatile component
R = mols of reflux
V = mols of vapor from plate n+1 in rectifying section
$\bar{V}$ = mols of vapor from plate m+1 in stripping section
x_B = mol fraction of less volatile component in bottom product
x_D = mol fraction of less volatile component in overhead product
x_m = mol fraction of less volatile component in liquid from plate m in stripping section
x_n = mol fraction of less volatile component in liquid from plate n in rectifying section
y_{m+1} = mol fraction of less volatile component in vapor from plate m+1 in stripping section
y_{n+1} = mol fraction of less volatile component in vapor from plate n+1 in rectifying section
α = relative volatility constant

Literature Cited

1. Fenske, *Ind. Eng. Chem.*, *24*, 482 (1932).
2. Fowler, *Pet. Engineer*, *18*, 57 (1947).
3. Robinson and Gilliland, *Elements of Fractional Distillation*, McGraw-Hill (1942).

* * *

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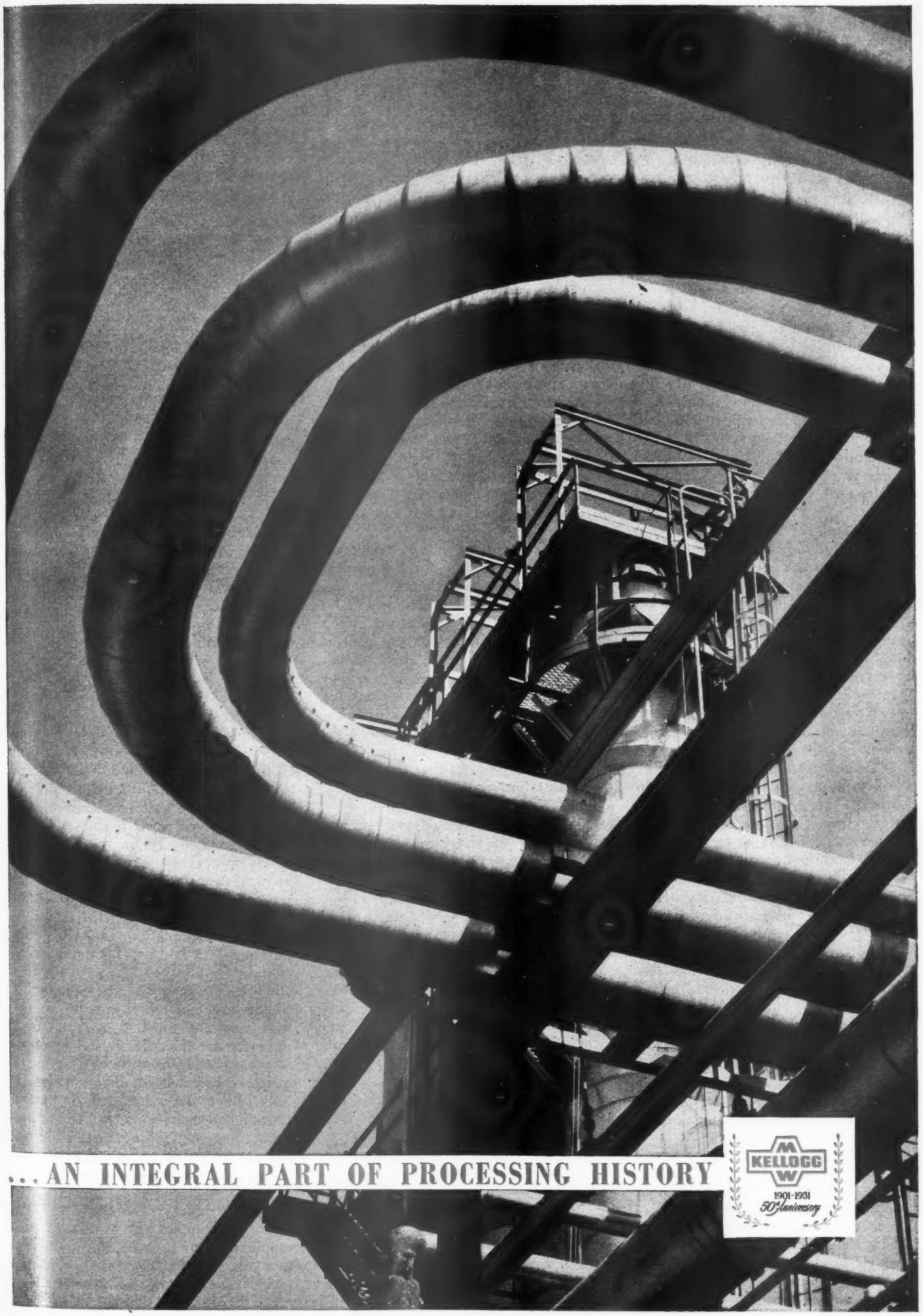
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More LPG for Motor Fuel, NGAA Told

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EACH year more and more LPG (liquefied petroleum gases) sales are being made, and each year the volume consumed approaches more closely the industry's manufacturing capacity, A. M. L. Kube and S. C. Carney, Phillips Petroleum Company told the Panhandle-Plains Regional meeting of the Natural Gasoline Association of America in Amarillo, Texas, December 8, 1950. This means, says Kube, that "in a period of years" consumption capacity will exceed production capacity, for LPG, if manufacturers do not come up with some new ideas for recovery and retention of these lighter hydrocarbons.

Discussing the Kremser and Brown equations for the efficiency of absorption, the author stated that these equations indicate that no matter how good the absorption process may be, the hydrocarbon content of the residue gas can never be reduced below the amount of any component that is in equilibrium with the denuded (lean) oil entering the top of the absorber. In order to improve efficiency, eliminate undesired methane from absorption oil and lower costs the practice now is to install demethanizer columns in many plants. To obtain maximum absorption in the demethanizer the oil is cooled in the upper part of the column; to strip the oil of the maximum methane content a heater is placed in the vessel's bottom. Not all plants can use the demethanizer efficiently, and its principle is not new. The reason for its present popularity is that more propane must be produced as cheaply as possible. By cutting deeper into the stream and removing the ethane, making the demethanizer a deethanizer, specification propane can be made with a separate deethanizer column, Kube stated.

Utilization of LPG, propane and butane and mixtures thereof is growing by leaps and bounds, especially in the fields of tractor, truck, and farm-and-home applications, O. L. Garretson and A. J. Turner of General Tank and Steel Corporation stated in discussing new methods for carburetting and burning these products. As time goes on equipment manufacturers will see fit to produce much larger numbers of engine units designed and equipped specifically to operate on LPGas, Garretson stated. Present estimates indicate that about 75,000 tractors will have been converted to the use of the ultra-light fuel during 1950, and that this number will be doubled during 1951 unless world conditions interfere seriously with the development. The present rate of conversion is widely variant, it is stated, with more than 2000 having been made in Illinois during 1950, while in some other Midwestern states the conversions have been only 5 to 10 per cent of that number. Distribution of fuel throughout a territory governs in good measure the spread of the use of LPGas for automotive fuel.

Few farm tractors can be converted economically to LPGas if the price differential between that and motor fuel is 3 cents per gallon or less. A price differential of 5 cents per gallon will net $100 per year on the average tractor consumption of 2000 gal per annum, a sum large enough to underwrite the lowest cost conversions for farmers who expect a one-year "payout" time. Where tractors use 4000 gal or more annually, this price difference will pay out the more expensive installations in a year ($200), otherwise 2 years must be used.

The farm engine fuel market, and the fueling of irrigation and other stationary power plants form the most logical of all applications of butane and propane per se. As the famous authority, G. G. Oberfell, stated once, Garretson says, "It is an economic crime to take such a perfect engine fuel and grind it up, at considerable cost and volume loss, to make gasoline, or to burn it for refinery fuel or as a constituent of natural gas where its valuable properties are not utilized fully." With 4,000,000 farm tractors in the United States, operating in a small radius, easily refueled and with engine life of 10 or more years, the prospects for this outlet for these light hydrocarbons is hopeful, Garretson indicated.

New Valve Developments

Very large single-seat valves operated by diaphragm motor arrangements and working at pressures up to 5000 psig have been made far more efficient than has been the case heretofore, says P. A. Elfers of Fisher Governor Company. Single seat designs are better than double, since the latter are wasteful of material in leakage when the valve is not perfectly tight. For flare relief valves the trim and stem materials may be hardened chrome stainless No. 440 of 450-475 Brinnell, along with such alloys as Stellite. The newer types of valves show much less tendency to freeze up, Elfers stated; they are designed so that the coldest temperature zone is away from the main body portion, a design taken advantage of in high pressure field station construction. Steam in the valve body jacket helps along this line, also, by preventing or minimizing hydrate formation.

Valve packings have been improved greatly in recent years, Elfers pointed out. Development of a new fluorine plastic—Teflon—makes it practicable to operate valve packings at up to 500 F; cooling fins are employed where necessary to hold stuffing box temperatures below that value. This product is inert to practically everything except molten caustic (soda).

Employed properly while making allowance for temperature growth Teflon gives extremely low leakage with a minimum of friction in control valves, the author stated. At 150 psig gas pressure or higher, a properly tightened Teflon packing will show only about 20 per cent of the stem friction shown by a conventional packing. Life span of V-ring Teflon packing is not known with certainty but present indications are that it will be from 5 to 10 years, without attention.

Surface finish on valve stems is highly important in using this packing, must be finished to roughness of not more than 6-8 RMS; replacement of packing normally will require replacement of the stem, probably, since the latter will be worn beyond fitting. Diameters and other dimensions of stuffing box, packing, and stem must be correct if this packing is to function satisfactorily.

Cooling Tower Operation

Formulation of any system of recommendations for water cooling methods to fit all general cases is impossible, says Howard E. Degler, technical director for The Marley Com-

pany. Before such recommendations can be made intelligently it is necessary to analyze thoroughly the operating features, anticipated performance and maintenance characteristics of a proposed installation, and final choice often becomes a matter of engineering compromise.

Treatment of cooling water to increase efficiency of the cooling tower and to preserve its equipment, as well as to improve water quality, includes minimizing scale formation in heat exchangers, boilers, etc., prevention and control of algae, and the control of delignification of tower woods. Scale can be minimized by treating with lime-soda, zeolites, sulfuric acid, chromates, or soluble phosphates. Algae may be prevented from depositing by the addition of small well-regulated amounts of chlorine. As delignification is generally caused by combination of sodium carbonate in the water with the lignin binder in the wood fiber, the problem is met mainly by controlling the amount of sodium carbonate in the water supplied to the tower. Old oil should be drained from speed reducers on draft fan systems each 3000 hours of operation, and should be replaced with the proper indicated grade of oil; oil change should be twice per year at the minimum, Degler said. Drift eliminators should be cleaned whenever appreciably dirty. A regular system of inspection and maintenance should be set up and adhered to rigidly.

Other important if non-technical problems were discussed before the one-day meeting, such as "Why Some Men Lose Jobs," "Kinks and Operating Ideas," etc., to make the meeting a well-rounded presentation. Formal sessions were followed by a banquet in the early evening.

Universal Announces Price Increases

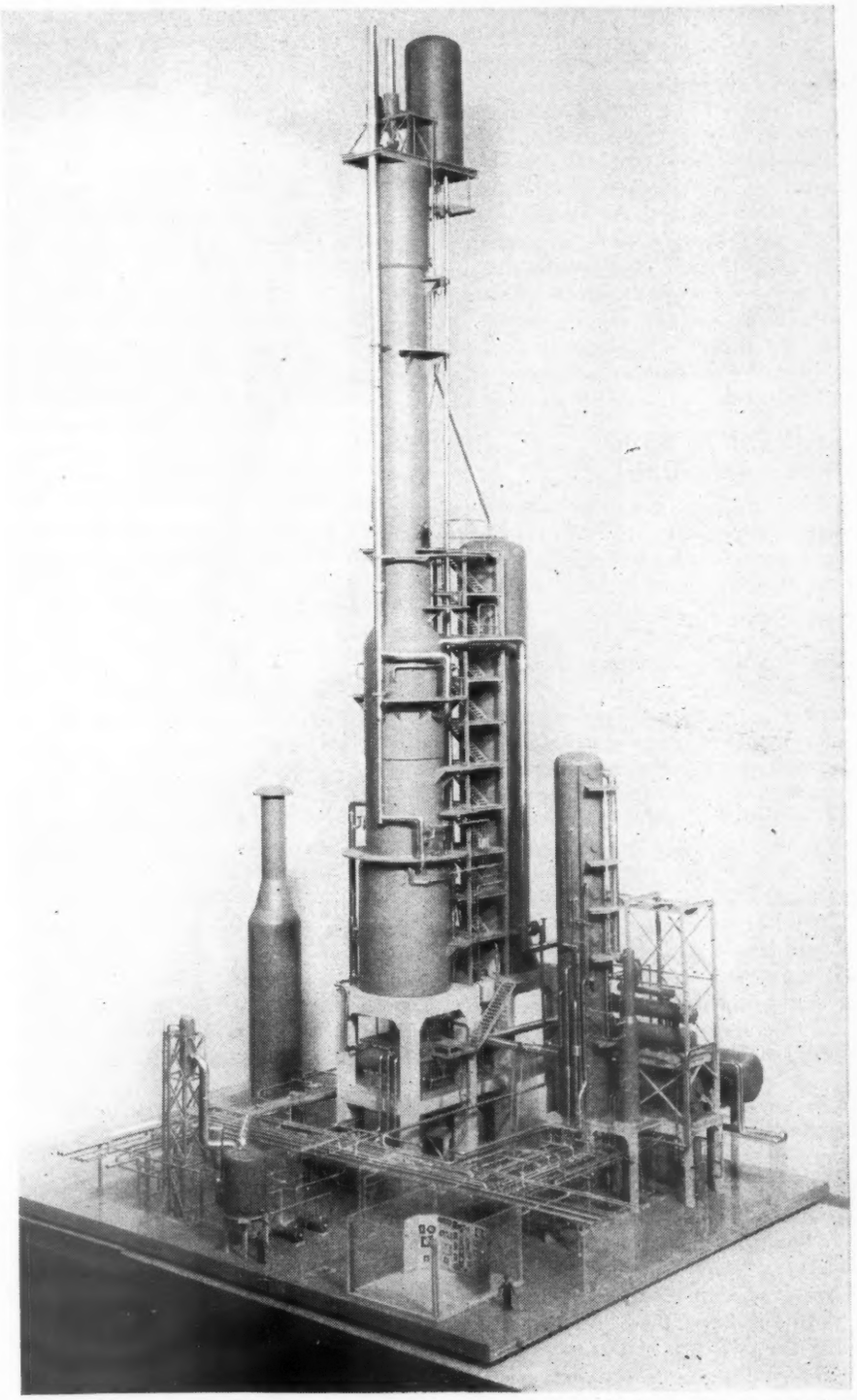
Universal Oil Products Company has announced price increases on their butyl amino phenol and para phenylene diamine gasoline inhibitors, marketed as UOP Nos. 4 and 5, UOP No. 4 will then be sold at 59 cents per pound, representing 4 cents per pound increase, while U.O.P. No. 5 will be raised 7-½ cents per pound to $1.17-½.

Universal attributes the price increases to rising prices of raw materials and mounting labor and distribution costs. At the same time it was announced that although inhibitor supplies appear adequate, the critical supply of steel has necessitated that deliveries after December 1 be handled on returnable container basis.

S/V Sovaloid C Now Available

With expansion of manufacturing facilities at the company's refinery in Olean, New York, the Socony-Vacuum Oil Company, Inc., has announced S/V Sovaloid C, a plasticizer, is now available to the vinyl resin and nitrile rubber industries in unrestricted quantities. Socony-Vacuum was forced for many months to ration supplies of S/V Sovaloid C because demand outstripped the available production facilities.

Introduced several years ago, S/V Sovaloid C is suitable for use in conventional vinyl compounds and plastisols as well as in nitrile rubber formulations. It is a light-bodied oil with an unusually high specfic gravity, a synthetic product made by a chemical rearrangement of petroleum hydrocarbons, Socony-Vacuum reported.



New Shamrock Plant. Scale model of 11,000 bbl-per-day Houdriflow catalytic cracking unit now under construction for the Shamrock Oil and Gas Corporation, at Sunray, Texas. Completion of the unit, which is being erected by Catalytic Construction Company, under license from Houdry Process Corporation, is expected early this year.

Gilliand Claims Government Backed Research Hazardous

The high percentage of all research work being financed by the Government, particularly the military services and the Atomic Energy Commission, is a potential hazard to the country, E. R. Gilliland, 1950 winner of the Celanese Corporation of America Professional Progress Award in chemical engineering, declared in an address before the annual meeting of the American Institute of Chemical Engineers. Gilliland is a professor of Chemical engineering at MIT.

"There are several aspects of this problem that are dangerous," Gilliland said. "First, there is a tendency to channelize research and development work into certain research fields at the expense of others of equal importance. In fact, some of the neglected fields will probably be of more importance in a real emergency than some of those being actively pushed. Second, a considerable portion of it is not research, but development work."

Shell Oil To Build Platforming Units

Plans to construct two new refinery units, largest of their kind ever built, were announced by Shell Oil Company. Called "Platforming" units, the new installations are designed to raise the supply and quality of motor gasoline, and at the same time to maintain top production.

Process to be used, which was developed by the Universal Oil Products Company, will convert low-quality naphthas into high-octane-number components for gasoline. One unit will be built at Shell's Wood River, Illinois, refinery; the other, identical to the first, will be at Houston, Texas.

"Each Platforming unit will process naphthas at the rate of 630,000 gal a day and will cover an area the size of a city block," F. S. Clulow, vice president in charge of manufacturing, stated.

B of M Tests Latest Shale Oil Recovery Method

The new pilot-plant sets developed by Bureau of Mines engineers for extracting oil from oil shales may provide the most efficient and economical method of producing shale oil to date, Secretary of the Interior Oscar L. Chapman has stated. A pilot-plant using the new process, known as the combustion process, has achieved a high recovery of liquid oil and demonstrated high capacity during a 10-day test run at the Bureau's oil shale mine and plant at Rifle, Colorado.

Oil yield during the test run averaged about 95 per cent of the Fischer assay value of the shale treated, and the retort handled some 200 lb of shale an hour for each square foot of area.

The new process utilizes a vertical retort which is continuous in operation. Raw shale is fed into the top of the retort and moves downward by gravity against an upward current of hot gas, which is drawn off near the top of the retort and passed to a recovery system. As the downward moving shale and the rising gas pass each other, the shale is heated and the gas is cooled, which results in high thermal efficiency. Additional heat is supplied by burning part of the preheated gas with air.

Oil from Coal Fields

A report from Salisbury to the crown colonist of London states that Southern Rhodesia will produce oil from her huge Wankie coal fields. The dispatch quoted Prime Minister Sir Godfrey Huggins as saying that building of the first synthetic oil plant is to begin within a year, after a general commission decides on the best process to use. A similar project to produce oil from coal is currently pending in South Africa, where low-quality coal from deposits in Natal and the Transvaal will be used. Both African nations are without known oil fields and import the fuel from the Middle East.

Coal Firm to Invest In Carbon Black Plant

Stavely Coal and Iron Ltd. has announced that it plans to invest $500,000 in the carbon black project of Philblack Ltd., The Petroleum Times reports. Philblack's plant near Avonmouth is nearly completed. Stavely Coal will also nominate three representatives of the Philblack board, and provide from their staff a general manager for the company. When in full operation, the plant will produce at the rate of 50,000,000 lb of Philblack a year—30,000,000 of the "O" type and 2,000,000 of "A" type.

Winter Gasoline Produced

Development of an improved regular-grade gasoline giving the winter advantages of premium grade at the price of regular is announced by Standard Oil Company (Indiana). One-second starting and faster warm-up, the company said, are features of these premium winter advantages.

The new gasoline gives "11.7 per cent faster warm-up than the average regular gasolines in use last winter and 6.5 per cent faster warm-up than the average 1949-50 winter premium gasolines," according to the company. The new product is known as the "new 1951 Standard Red Crown gasoline."

Carbon Black Plant to Open 2 Units in February

The furnace carbon black plant of General Atlas Carbon Company, wholly owned subsidiary of Godfrey L. Cabot, Inc., at Big Spring, Texas is progressing rapidly toward completion, and the first two units are expected to be in operation by February 1, 1951, according to C. J. Wright, general manager of GAC. The plant eventually will consist of 4 units, 2 of which will begin operations by February 1, and the other two will be ready by April 1, 1951, according to present plans, Wright stated.

This plant will employ as its main charge stock a heavy, cracked oil obtained from Cosden Petroleum Corporation, and the gas required for the process will be supplied by Empire Southern Gas Company, another local concern. The oil is a heavy, cracked product, very high in aromatics and relatively low in "fixed carbon residue", to quote researchers interested in the process of converting heavy oil to carbon black. The plant will have a capacity of 50,000,000 lb of black per year, and will employ up to 50 men for its operation. According to specialists in the carbon black-rubber field, furnace black is more useful in perfecting synthetic rubber, and the older product, so-called channel black is more applicable to natural rubber products. The main charge is from thermal cracking still residues.

Kansas Refinery To Expand

Plans for expansion of refining capacity at the Neodesha, Kansas, refinery of Standard Oil Company (Indiana) to help meet the military and civilian demand for more and improved petroleum products were announced recently by M. G. Paulus, vice president in charge of manufacturing. Engineering work has already begun, he said. Actual construction will begin soon with the greatest activity scheduled for the middle of 1951.

The first construction involves increasing the crude running capacity of the Neodesha refinery by 9300 bbl per day. Paulus said this increase will almost double the capacity of the refinery, which currently processes 10,400 bbl of crude oil per day. Existing crude oil distillation, coking, and rerunning units will be revamped. In addition, new tankage and utilities equipment will be installed together with new facilities for improvement of product quality.

Surplus cracking stock will be moved from Neodesha to Standard's refinery at Sugar Creek, Missouri, for processing on the catalytic cracking unit completed there in 1948.

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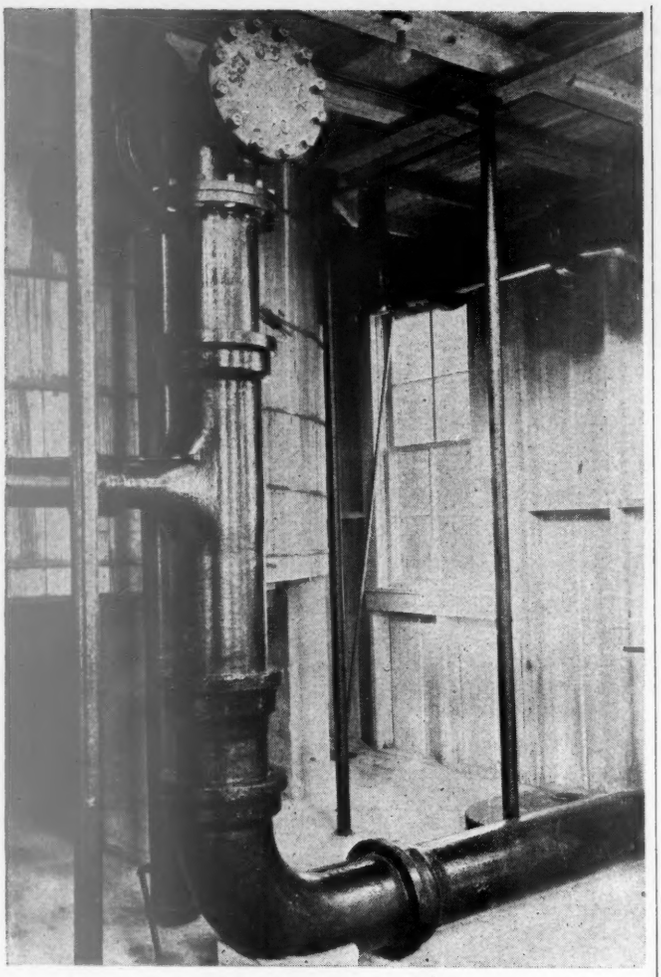

DIRECT ROUTE TO LOWER PLANT MAINTENANCE

The direct and indirect expense of replacements of short-lived refinery pipe lines can be reduced, or avoided altogether, by the use of cast iron pipe. This has been proved by many refineries whose maintenance costs have been lowered by replacing other pipe materials with cast iron.

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SAE Oil Classification Revised

The two tables given below show the new, revised lubricating (crankcase) oil classification data just recently adopted by the Society of Automotive Engineers (Table 1), as compared to the old classification data (Table 2).

It is noted that grades 60 and 70 have been eliminated, because of their very limited range of usefulness. The new, experimental 5W classification of very light oils for extreme winter conditions has been added to the list after extended trial in northerly climates at zero and subzero temperatures. Their use has shown 33 per cent average cranking speed as compared to 10W grades. Also, the two winter grades 10W and 20W have been added to the regular classification.

In place of 130 F as the viscosity temperature point for the 10, 20, and 30 grades, zero F for winter oils and 210 F for all other oils are the temperatures at which grades are classified as to viscosity. An interesting provision also is that minimum viscosities at 0 F can be waived on 10W and 20W if their 210 F viscosities are above 40 and 45 Saybolt seconds, respectively. The revised classification was adopted and approved by the SAE Fuels and Lubricants Technical Committee chairman, M. D. Gjerde, Standard Oil Company (Indiana) on October 3.

Table 1—Revised SAE crankcase oil classification.

SAE Viscosity Number	Viscosity Range, Saybolt Univ., Sec. at 0 F		at 210 F	
	Min.	Max.	Min.	Max.
5W	—	4000	—	—
10W	6000 (Note A)	less than 12,000	—	—
20W	12,000 (Note B)	48,000	—	—
20	—	—	45	less than 58
30	—	—	58	less than 70
40	—	—	70	less than 85
50	—	—	85	110

Note A. Minimum viscosity at 0 F can be waived provided viscosity at 210 F is not below 40 Saybolt Seconds Universal.

Note B. Minimum viscosity at 0 F can be waived provided viscosity at 210 F is not below 45 Saybolt Seconds Universal.

Table 2—Former SAE crankcase oil classification.

SAE Viscosity Number	Viscosity Range, Saybolt Univ., Sec. at 130 F		at 210 F	
	Min.	Max.	Min.	Max.
10	90	Less than 120	—	—
20	120	Less than 185	—	—
30	185	Less than 255	—	—
40	255	—	—	less than 80
50	—	—	80	less than 105
60	—	—	105	less than 125
70	—	—	125	less than 150

Butadiene Plant Reactivated

The Petroleum Maintenance Company of Wilmington, California, has recently completed the reactivation of a large butadiene plant at the El Segunda refinery of Standard Oil Company of California. This synthetic rubber producing plant has been idle for several years and was restored to its World War II operational capacity by authorization of the Reconstruction Finance Corporation, Office of Rubber Reserve, which selected Petroleum Maintenance for the job.

The planning, tooling, and execution of this project was under the direct supervision of Robert L. Noble, superintendent for Petroleum Maintenance. The work included repairs to approximately 3000 valves of various sizes from ½ in. to 24 in.; the repair to some 125 control valves from ¾ in. to 10 in., inspection and repair to 54 Limitorque valves from 6 in. to 24 in., etc.

Peroleum Maintenance has also under contract reactivation of a catalytic cracking plant for Wilshire Oil Company at its Norwalk, California refinery.

—PERSONALS—

▸ **Dr. Arthur A. Orning** of the Carnegie Institute of Technology has been elected chairman of the American Chemical Society's division of gas and fuel chemistry. He took office January 1, succeeding **Dr. R. E. Brewer,** chemical engineer with the United States Bureau of Mines in Pittsburgh, Pennsylvania. **Dr. John Farley Foster** of the Battelle Memorial Institute, Columbus, Ohio, was named chairman-elect, and **H. Beecher Charmbury** of Pennsylvania State College was re-elected secretary.

Born in Gilbert, Iowa, in 1906, Orning was graduated from Iowa State College in 1934. He received the M.S. and Sc.D. degrees at the Carnegie Institute and joined the staff of the Institute's coal research laboratory in 1938.

▸ **James R. Withrow,** emeritus professor and former head of the department of chemical engineering at Ohio State University has been honored by an award of the Central Ohio section of the American Institute of Chemical Engineers, at the 43rd annual meeting of the AIChE, in Columbus. The recognition was made to Withrow for his long connection with, and pioneering work in, chemical engineering education in Ohio. A scroll of testimony was presented by A. W. Davison, research director of Owens-Corning Fiberglas Corporation and president of the Central Ohio section of the AIChE. Withrow received his doctorate degree from the University of Pennsylvania in 1905, and later came to Ohio State where he became its first industrial chemistry lecturer in 1906.

▸ **Carroll A. Hochwalt** and **Felix N. Williams** have been appointed to Monsanto Chemical Company's executive committee by the board of directors, it was announced recently. This increases the company's executive committee to 6 men. Other committee members are **Charles Allen Thomas,** chairman; **Edgar M. Queeny; William M. Rand,** and **R. R. Cole.** Hochwalt is a vice president and a member of the board of directors. His sphere of activity will include the research, development, and patent activities of the company. Williams also is vice president and a member of the board of directors. His sphere of activity will include sales, advertising, foreign and specialty products.

▸ **F. M. Tiller,** associate professor of chemical engineering at Vanderbilt University, Nashville, Tennessee, has won the Junior Award of the American Institute of Chemical Engineers. The honor is given for outstanding contributions to the literature of chemical engineering. Tiller received the Junior Award at the annual meeting of the AIChE, which was held in Columbus, Ohio, December 3-6, 1950. Tiller was chosen on the basis of his paper, "Efficiencies in Gas Absorption, Extraction, and Washing," published in the magazine Chemical Engineering Progress in 1949.

▸ **Thomas H. Chilton,** technical director of the development engineering division of E. I. duPont deNemours and Company, has been elected president of the American Institute of Chemical Engineers for 1951. At the same time, it was announced that the members had also, through their mail ballot, elected as vice president **William I. Burt,** who is a vice president of the B. F. Goodrich Chemical Company. **Stephen L. Tyler** and **C. R. De Long,** both of New York City, were re-elected secretary and treasurer respectively.

Four new Directors were chosen by the chemical engineers. They are **Charles R. Nelson,** manager of the process engineering department of the Shell Development Company; **Earl P. Stevenson,** president of Arthur D. Little, Inc.; **R. C. Gunness,** manager of research of the Standard Oil Company (Indiana); and **R. Paul Kite,** manager of the development department of The Dorr Company.

The new president, Thomas H. Chilton, has been with duPont since 1925 where he first began in process development and unit operations research for the chemical department. He is a graduate of the University of Alabama and Columbia University.

▸ **Professor Cecil E. Boord,** Ohio State University professor will present an account of the hydrocarbon research program that he has directed on the Ohio State University campus for the past 12 years at the Third World Petroleum Congress at The Hague this spring. Preceding the Netherlands meeting, he will speak before a meeting of the Petroleum Division of the American Chemical Society in Cleveland in early April.

J. A. Altshuler

▸ **J. A. Altshuler,** executive vice president of Stratford Engineering Corporation of Kansas City, Kansas died November 27 of a heart attack at the Menorah Hospital in that city, at the age of 48 years. Altshuler was widely known in this country and abroad as a chemical engineer and in the development of outstanding equipment and processes for the oil refining and allied industries.

A chemical engineer graduate from the University of Pittsburgh, 1923, Altshuler was employed on the technical staff of Associated Oil Company until he joined the Stratford company in 1928. In addition to the installation of numerous units in refineries in this country he built refineries in Europe, (Rumania), and had just last year completed a tour of European oil refining facilities, and had concluded plans for building a refinery in England. He has been a consultant on the panel for the Technical Forum of The Petroleum Engineer's Refining and Gas Processing edition since that department began more than a year ago. He was prominent in Jewish religious circles in Kansas City, and in civic and other public activities of various kinds.

▸ **Charles W. Beckett** has been appointed to the thermodynamics section of the National Bureau of Standards where he will be active in the preparation of tables of thermal properties of gases. This project tabulates various thermodynamic properties of gases which are of importance in the design and operation of wind-tunnels and jet-engines. Beckett was a research associate of the American Petroleum Institute at the University of California from 1945 to 1947, where he did research on properties of hydrocarbons and statistical thermodynamics calculations. He received his B.S. from the University of California in 1943, and his Ph.D. in 1945.

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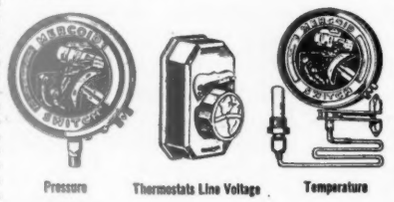

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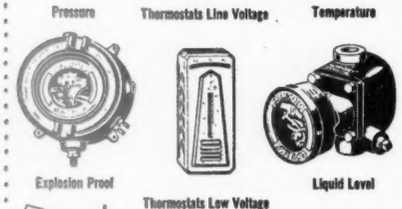

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▸ **Barnett F. Dodge,** professor of chemical engineering and head of the department of chemical engineering at Yale University, became the 15th recipient of the William H. Walker Award at a banquet of the American Institute of Chemical Engineers in Columbus, Ohio. The award was presented to him by Warren L. McCabe, president of the AIChE, and a vice president in charge of research of the Flintkote Corporation.

An award committee headed by Dean T. K. Sherwood of Massachusetts Institute of Technology made the original selection of Dodge as the recipient of the Walker Award, stating that he had earned the honor "in recognition for his outstanding contributions to the literature of chemical engineering over the years." Dodge was cited for his work on manufacture of oxygen and thermodynamic studies.

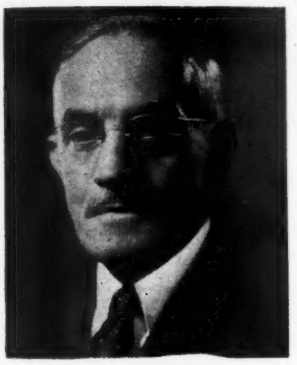
▸ **M. P. L. Love** has been appointed manager of Shell Oil Company's Houston, Texas refinery, succeeding **P. E. Foster** who has retired after 35 years with the company.

Foster joined Shell as a loader at the company's Martinez, California, refinery in 1916. He became manager of the former Arkansas City refinery in 1928 and was transferred to a similar post at the company's Norco, Louisiana, refinery at the end of 1928. He remained there until 1943 when he was named manager at Houston.

Love is a graduate of Mississippi College. He first joined the company in 1927, but later returned to graduate school at the University of Virginia. He rejoined the company permanently in 1935 as a chemist at the Wood River, Illinois, refinery.

▸ **P. K. Kuhne,** Gulf Oil Corporation, assistant to the general manager, manufacturing department, has been given the added assignment of assisting in the administration of the technical division of the manufacturing department. Kuhne received a Bachelor of Science degree in chemistry from Tulane University in 1927. He joined Gulf as an assistant chemist in the Port Arthur refinery in 1927 and subsequently became chief chemist, Philadelphia refinery, in 1930, and supervisor of the refinery technology division there in 1934.

▸ **Norman Fawley** has been named head of the oil-conservation division at Esso Standard Oil Company's Baltimore, Maryland refinery. **David Lewis** was named technical assistant in the process department in charge of catalytic cracking and lightends operations. **William Sheridan** has been appointed technical assistant to the process superintendent.



Gustav Egloff

▸ **Gustav Egloff,** Universal Oil Products Company, has been elected by the University of Edinburgh's Senatus Academicus, to give the biennial "Romanes Lecture in Chemisty for 1951."

Egloff, who is vice president of the Third World Petroleum Congress, will attend the Third Congress, in The Hague, May 28 to June 6, 1951, at which time he will lecture on "Polymerization of Olefinic Hydrocarbons."

▸ **Herman Pines,** a research coordinator at Universal Oil Products Company and associate director of the Ipatieff High Pressure Catalytic Laboratory at Northwestern University, recently returned to Chicago, Illinois from a five-week trip abroad. Pines visited Israel at the invitation of the Research Council of Israel to advise the government in connection with petro-chemical problems and the education of chemists. On his return he visited France, Holland, and England. He was the guest of the French Institute of Petroleum in Paris, where he delivered two public lectures.

▸ **Robert P. Bannon,** a chemical engineering graduate of the University of Illinois, June 1950, has won the A. MacLaren White Award for his solution, while an undergraduate, of an engineering contest problem. The contest is a yearly student activity of the American Institute of Chemical Engineers, and is open to undergraduates in chemical engineering curricula. The problem this year involved the purification of tallow by propane extraction, and it was created and judged by a special committee of chemical engineers from industry.

The second prize in the contest went to **Leonard R. Brooks,** a native of Tulsa, Oklahoma and a recent graduate of the University of Oklahoma. He is at present with the Tennessee Gas Transmission Company in Natchitoches, Louisiana.

Third prize went to **Charles E. Wicks,** a graduate of Oregon State College. He is now at Carnegie Institute of Technology.

Contractors Have Learned Value of Group Action

THE PIPE LINE Contractors Association will hold its third annual convention at the Shamrock Hotel, Houston, Texas, January 9 and 10. Three years ago when approximately 17 contractors held an informal meeting in Dallas and laid the ground work for this association there were few among them who thought that the association would make as much progress as it has in the last three years. Its membership has more than doubled during that period and now consists of every major pipe line contractor in the business. It has been estimated that the members of this association build approximately 85 to 90 per cent of all the pipe lines in the United States. In addition to the pipe line contractors, who are the active members of the association, the list of associate members has grown by leaps and bounds and now comprises a respectable cross-section of the suppliers, material and equipment dealers, manufacturers, and subcontractors who are connected with the pipe line contracting industry.

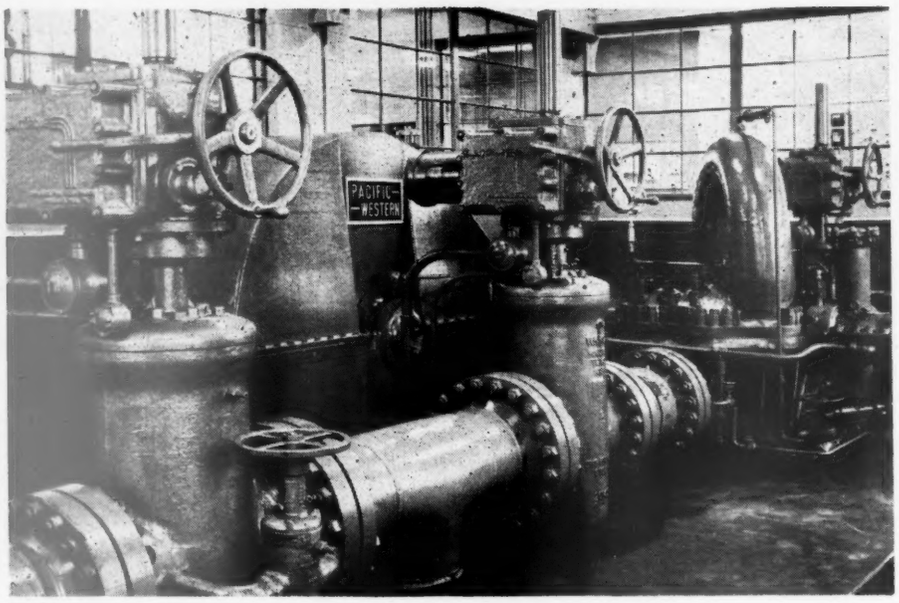
During the period of its existence the association has provided a medium never before available for pipe line contractors to sit down together in a meeting and discuss common problems that can be solved better by group action than by individual action. Whereas, before the existence of the association some contractors felt that there was no great need for such an organization, now without exception the pipe line contractors who are members of the association recognize its value as evidenced by the fact that whenever a meeting is called it is well attended by almost an unanimous membership.

The leadership of the organization has been in the hands of competent men who have been interested in accomplishing for the industry a recognition that has been long past due. The association was not formed for the purpose of making it anything more than a loosely knit association of contractors who could work together to solve mutual problems and plan projects that could not be accomplished by any one or two contractors singly.

It is expected that the annual convention in Houston will be attended by approximately 250 representatives of pipe line contractors and associate members. Many of the associate members have planned exhibits of equipment and new techniques in pipe line construction work. During the convention a president, two vice presidents, and a treasurer will be elected to succeed the present officers.

Membership in the Pipe Line Contractors Association is limited to general pipe line contractors who have had at least two years' experience in the construction of cross-country oil, gas, and gasoline pipe lines. It is affiliated with the Associated General Contractors of America, Inc., a nation-wide trade organization composed of building contractors, highway contractors, railroad contractors, and those engaged in heavy construction work. There are approximately 5500 contractors in the national organization and the Pipe Line Contractors Association is the only branch that is limited exclusively to pipe line contractors.

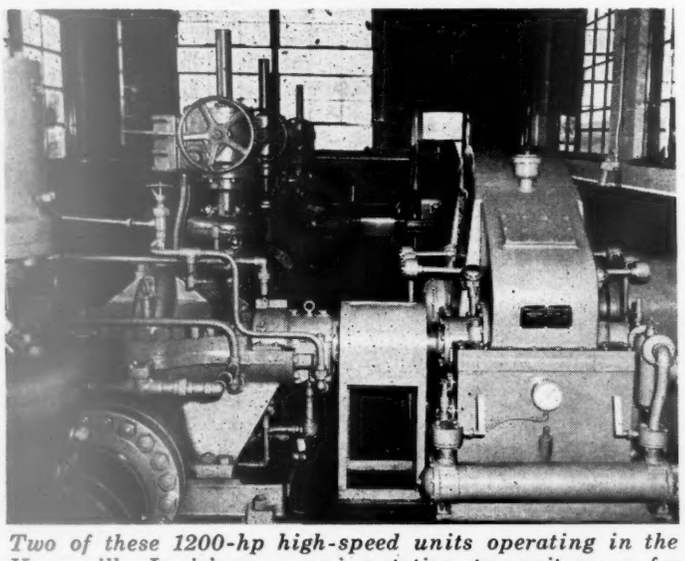
WESTERN GEAR DESIGNS, BUILDS LARGEST U. S. PIPELINE SPEED INCREASERS



Two of these 1700-horsepower Pacific-Western high-speed units installed at the Clarkson, Kentucky station of the Mid-Valley pipeline transmit power for pumping current requirements of 157,000 barrels of crude oil per day.

1000-Mile Mid-Valley Pipeline Uses Eight Western-Built High-Speed Units

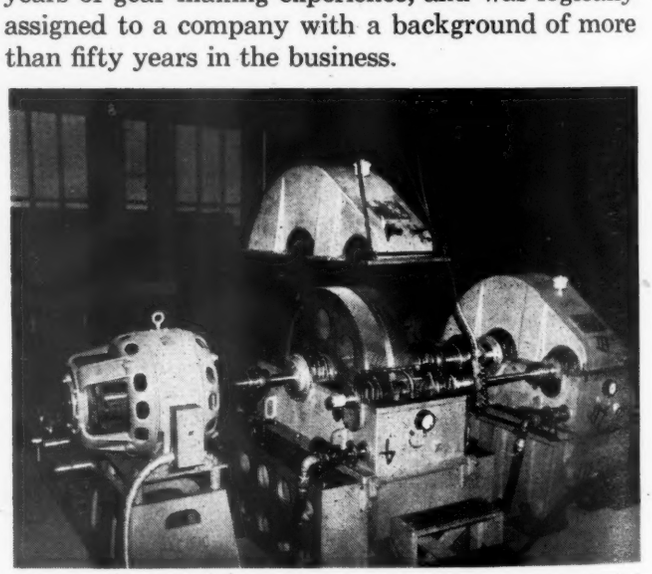
Four high-speed units of 1700 horsepower and four of 1200 horsepower are operating in pumping stations of the 1,000-mile Mid-Valley pipeline. All eight units were designed and manufactured in the Lynwood, California, plant of Western Gear Works. The 1700-horsepower speed increasers are the largest ever built for pipeline service in the United States.



Two of these 1200-hp high-speed units operating in the Haynesville, Louisiana, pumping station, transmit power for the delivery of current requirements of 108,000 barrels per day.

Numerous problems involved

The manufacture of gear units of this type involves many problems of design, lubrication, production, and testing. Particular emphasis was placed on sound levels, and these gears are exceptionally quiet in operation under full-load, full-speed conditions. The entire project of design and manufacture to the required specifications was one that called for many years of gear-making experience, and was logically assigned to a company with a background of more than fifty years in the business.



1200-hp Pacific-Western high-speed unit on test stand with cover removed. Gear requirements for the Mid-Valley pipeline are (1) transmitting 1200 hp at 453 rpm from a Diesel engine with step-up in ratio of 1:8 to a 3600-rpm centrifugal pump; and (2) transmitting 1700 hp at 329 rpm stepped up in a ratio of 1:11 to a 3600-rpm pump. The increases in speed are made in one stage, even for the extreme 1:11 requirement, and pitch-line velocities are as high as 7370 fpm. 5022

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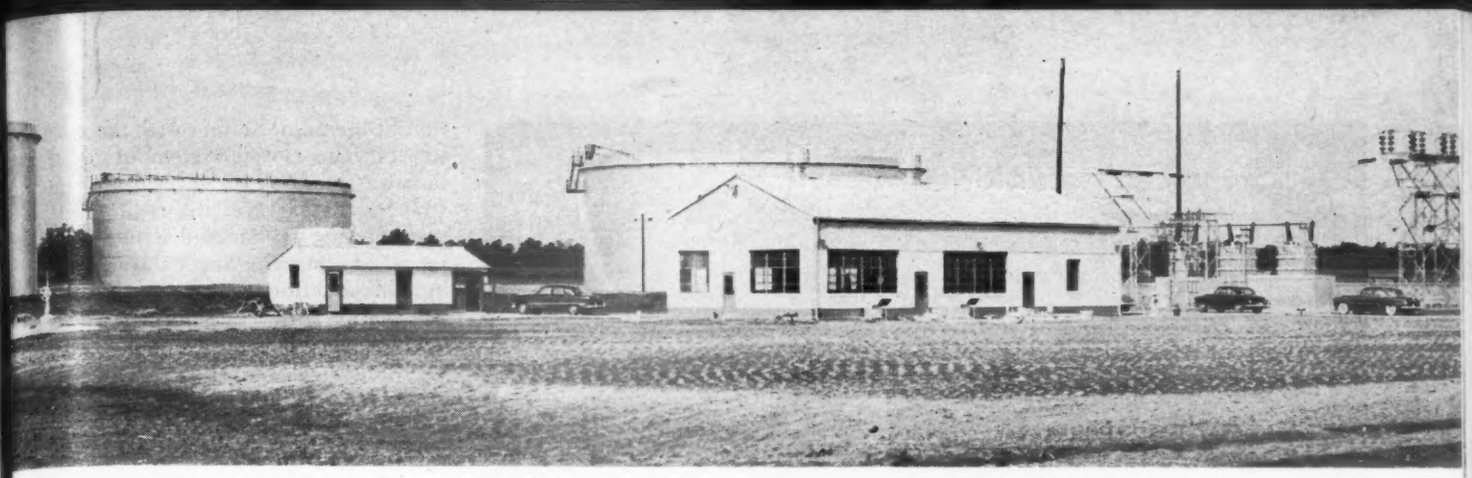


General view of the Mayersville, Mississippi, station.

P 615.51

Design of Mid-Valley Stations

Details of equipment selected for longest crude oil pipe line constructed during the last year in U.S.

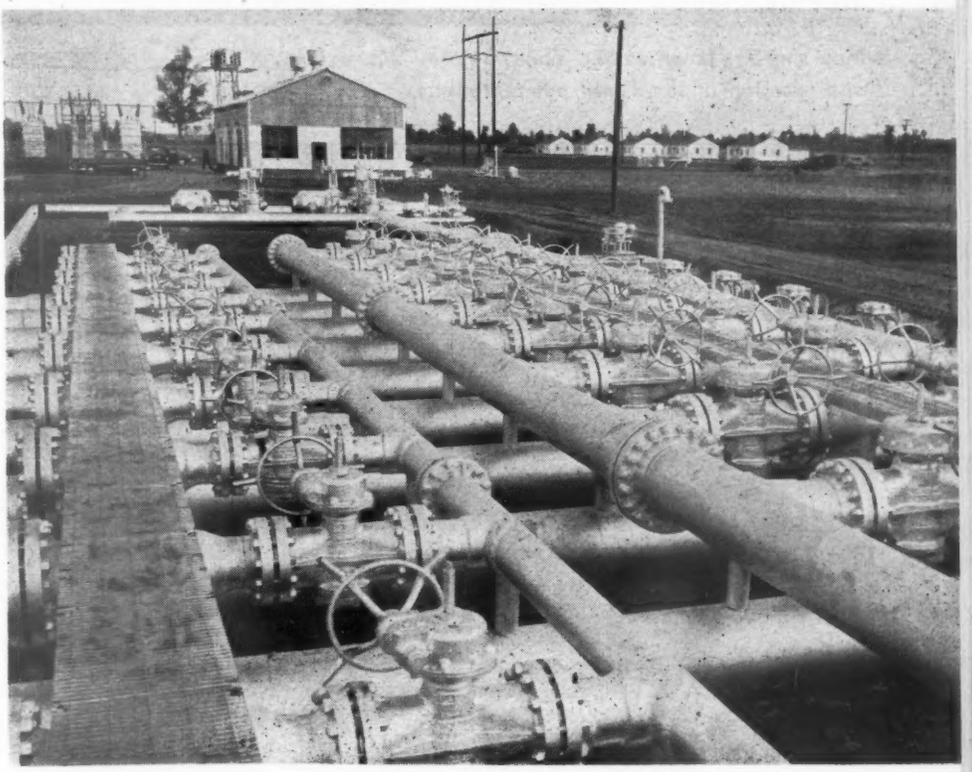
FRANK H. LOVE*

EXCLUSIVE

PUMPING stations on the new Mid-Valley Pipeline Company system between Longview, Texas, and Lima, Ohio, are of three types: Electric, diesel, and gas-diesel. The type of station installed was determined by the relative cost of energy in the various areas traversed by the line. Thus, electric stations were constructed at Mayersville, Mississippi; Abbeville, Mississippi; and Denver, Tennessee; gas-diesel stations at Longview, Texas, and Haynesville, Louisiana, and straight diesel at Clarkson and Hebron, Kentucky. At each of these there are two pumping units with provisions made for a third when ultimate capacity is desired. At that future time, also, six additional stations will be built.

Mid-Valley's main line consists of 20-in. pipe from Longview, Texas, to Mayersville, Mississippi; 22-in. from Mayersville to Hebron, Kentucky, and 20-in. from Hebron to Lima, Ohio. There are also four spur lines. One connects Magnolia, Arkansas, with Haynesville, Louisiana; another connects Delhi, Louisiana, to Mayersville, Mississippi; a third connects Tinsley, Mississippi, with Mayersville, and a fourth line extends from Hebron, Kentucky, to Sohio Petroleum Company's refinery at Latonia, Kentucky.

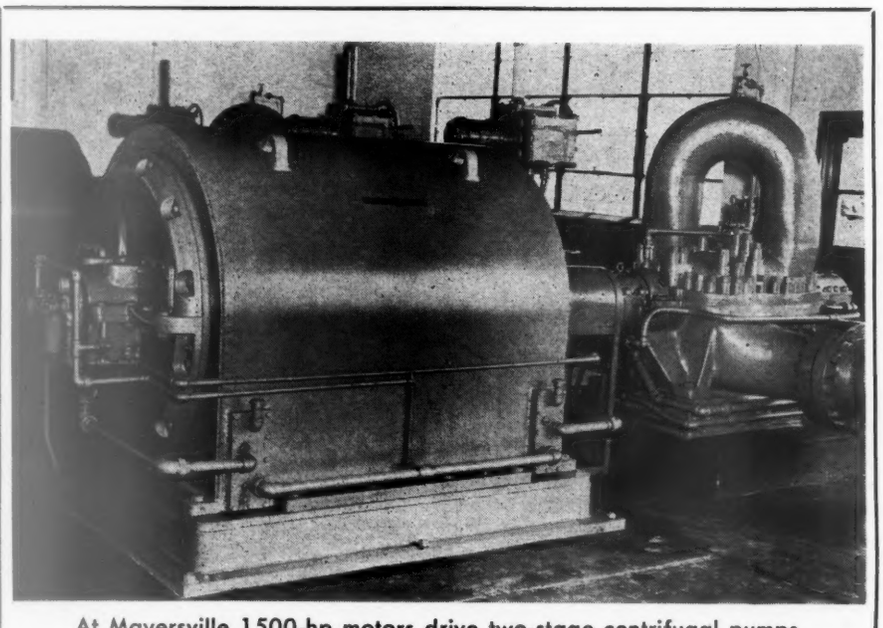
The system was designed for series operation and is closed except for those points (Haynesville and Mayersville) where oil is injected into the line, and at Hebron, where oil is dropped off for the Latonia refinery. The necessary tankage has been provided at such points for this operation. At Haynesville and Mayersville the crude oil is injected into the suc-



Suction and discharge manifold at Mayersville.

*Oil and Gas Pipelining Editor.

Map showing route of Mid-Valley system and location of the seven pump stations.



At Mayersville 1500-hp motors drive two-stage centrifugal pumps.

tion of the pumps along with the main stream. The closed system of operation was adopted for several reasons: (1) So that several different grades of crude can be handled with a minimum of commingling, and (2) to maintain suction pressure on the large size pumps with which the system has been equipped, and (3) reduction of handling or stock losses.

Pumps

Each station has two centrifugal pumps and under normal conditions they are operated in series. When a reduced pumping rate is desired, however, or when one of the pumps is down for repairs, a single pump is operated.

At Longview, where the Mid-Valley system originates, there are two 12-in. by 12-in. by 16-in. single-stage, double-volute, double-suction, horizontal split case pumps. The two pumps operating in series can deliver 108,000 bbl a day of crude oil against 500-psi (1390 ft) total head at 84 per cent minimum efficiency, 45 ft npsh (net positive suction head) at 3600 rpm. Each pump is driven by an 800-hp diesel engine.

The pumps at Haynesville are of the same type and size, but are set-up to deliver 120,000 bbl a day against 604-psi (1670 ft) total head at 83 per cent minimum efficiency, 45 npsh at 3600 rpm. These pumps also are driven by 800-hp diesel engines. Both the Longview and Haynesville stations are on the 20-in. part of the system.

The stations at Mayersville, Abbeville, Denver, Clarkson, and Hebron, on the 22-in. section of the line, are equipped with two 12-in. by 12-in. by 14-in., two-stage, double-volute, single-suction, horizontal split case pumps. The two pumps in series are designed for pumping 157,000 bbl a day against 915-psi (2516 ft) total head, at 86 per cent minimum efficiency, 45 npsh at 3580 rpm. Pumps at Mayersville, Abbeville, and Denver stations are driven by 1500-hp motors, and those of Clarkson and Hebron by 1715-hp diesel engines. Flexible couplings are installed between the pumps and motors, or between gear speed increasers and pump where diesels are used. A spacer sleeve (floating shaft) lengthens the coupling and makes it easier to line up the pump with the motor or gear speed increaser. The coupling makes it easy for the mechanical seal to be removed for repair or renewal without removing the upper half of the pump casing.

Booster pumps are provided at each station to serve specific needs. Each mainline station has at least one large booster that is capable of pumping

from the tanks all the oil required by the mainline pumps. In addition, a small booster pump has been installed at Haynesville, Mayersville, Abbeville, Denver, and Clarkson, for use when relatively small volumes of oil are required to supplement the incoming stream. At Longview, Haynesville, Mayersville, and Hebron, where operations are such that the pumps are used a good part of the time, two large booster pumps are installed assuring that should one break down another will be immediately available.

The following boosters have been installed:

Longview: Two 107,000-bbl-per-day pumps at 35 psi, driven by 150-hp, 1180-rpm motors.

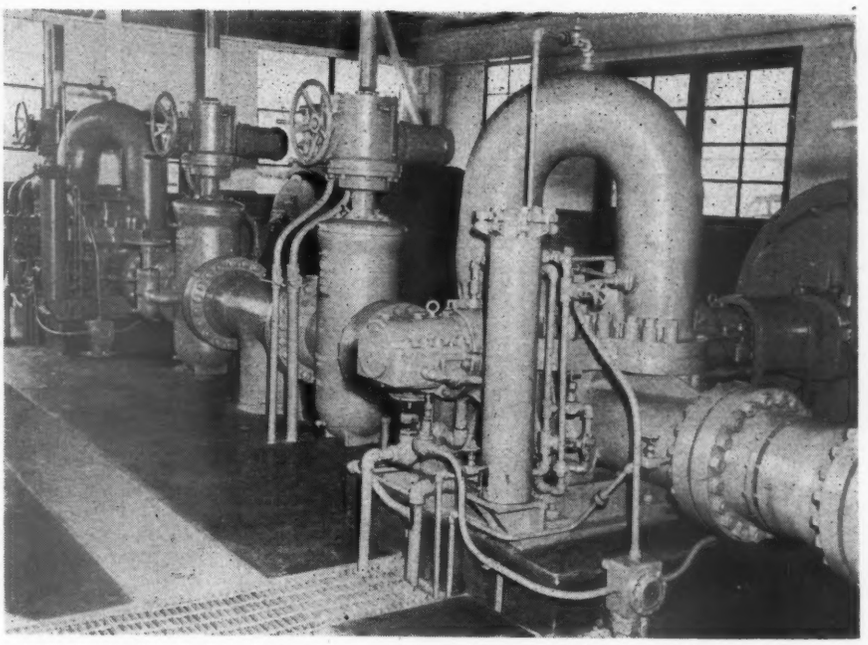
Haynesville: Two 120,000-bbl-per-day pumps at 35 psi driven by 150-hp, 1180-rpm motors; and one 11,500-bbl-per-day pump at 40 psi, driven by a 15-hp, 3600-rpm motor.

Mayersville: Two 157,000-bbl-per-day pumps at 40 psi, 150-hp, 1180-rpm motor; and one 37,000-bbl-per-day pump at 40 psi, driven by a 40-hp, 1750-rpm motor.

Abbeville-Denver-Clarkson: One 157,000-bbl-per-day pump at 35 psi, driven by 200-hp, 1180-rpm motor; and one 11,500-bbl-per-day pump at 40 psi, driven by a 15-hp, 3600-rpm motor.

Hebron: Two 143,000-bbl-per-day pumps at 35 psi, driven by 200-hp, 900-rpm motors.

The 157,000-bbl-per-day pumps at Abbeville, Denver, and Clarkson are driven by 200-hp motors, whereas the same type pumps at Mayersville are driven by 150-hp motors. The reason for this is that when the throughput of the line exceeds 157,000 bbl per day, larger impellers will be installed in the pumps at Abbeville, Denver, and Clarkson, and the 200-hp motors will be large enough to take care of the additional load, whereas at Mayersville another pump will be installed because the distance of some of the tanks from the station makes it necessary to use two pumps when handling volumes in excess of 157,000 bbl per day.

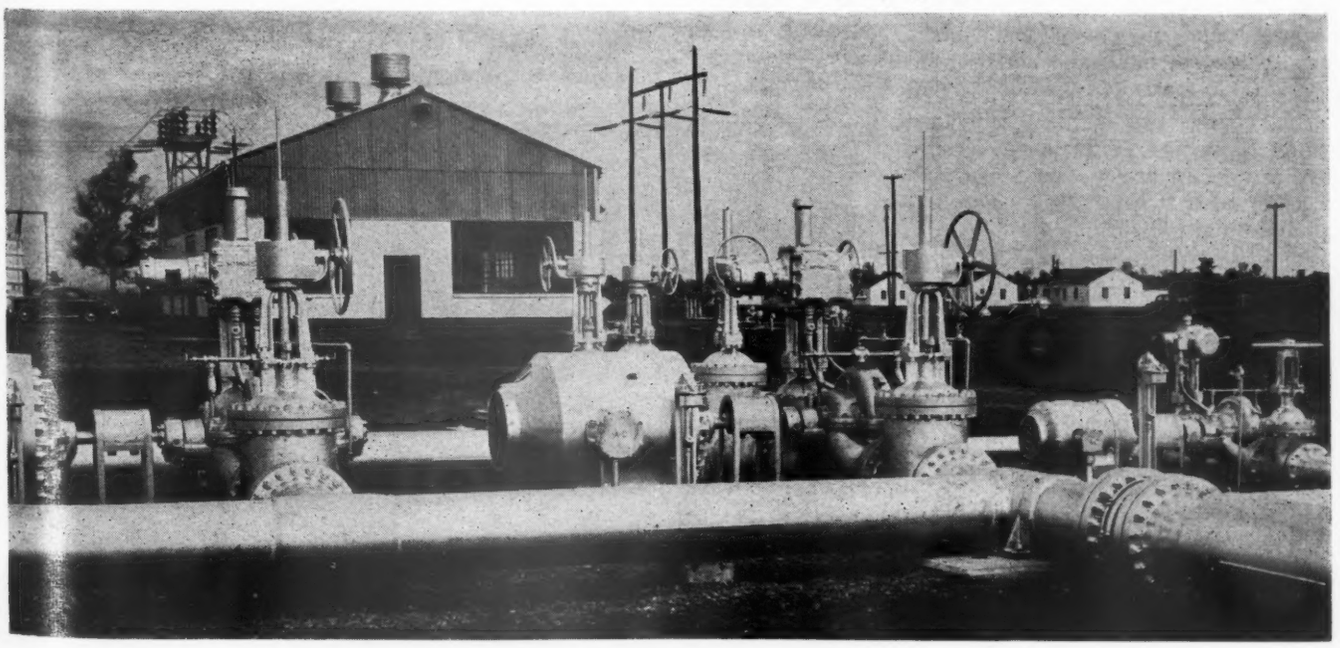


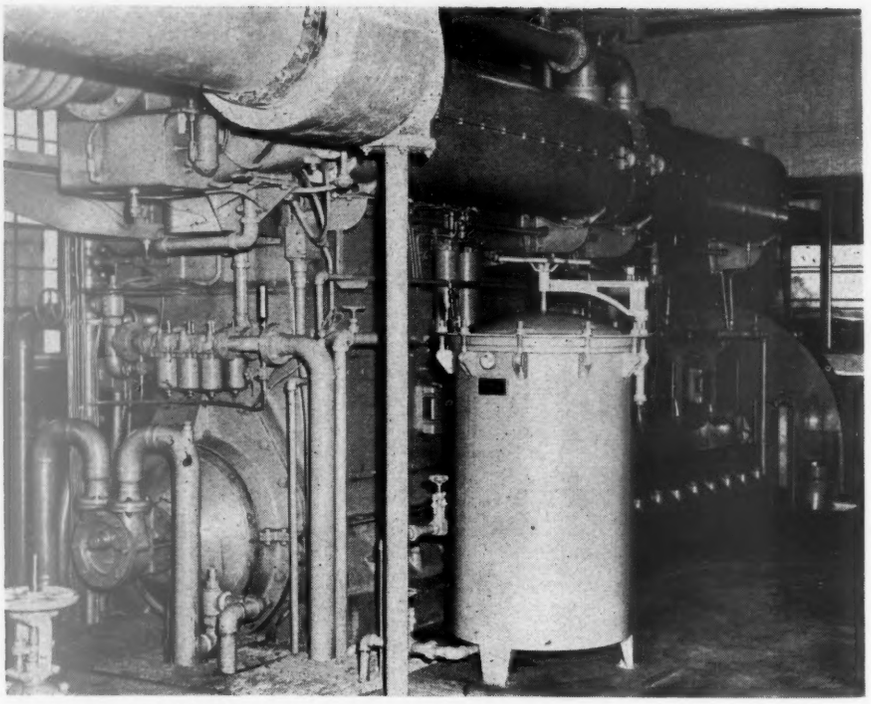
The two pumps at Mayersville, operating in series, can deliver 157,000 bbl a day against a total head of 951 psi.

Each station has two sump tanks, one 1000-gal and one 3000-gal tank, with the exception of Longview, which has one 3000-gal tank. Sump pumps are vertical, submerged, centrifugal units, and are driven by 3-hp, 1750-rpm motors. Static discharge head varies from 3 to 48 ft, as the sump pumps discharge into a storage tank. The pumps have a minimum capacity of 20 gal per min.

To deliver oil into the Haynesville station from the Magnolia area a field station was installed with two duplex piston pumps driven by gas engines. The pumps are operated in parallel and each can deliver between 15,000

Boosters for pumping from tanks into the mainline stream.





Supercharged diesel engine, 8-cylinder in-line, 4-cycle unit, of which there are two, installed at Clarkson, Kentucky. Lube oil filter in center foreground.

bbl of oil a day. The Magnolia field is connected to Haynesville by an 8-in. line.

At Delhi three 7-in. by 10-in. pumps driven by gas engines are operated in parallel to pump into the Mayersville station through a 12-in. line. Each pump is designed to deliver 12,500 bbl a day.

Diesel Engines

Mainline engines are 8-cylinder in-line, 4-cycle units. At Clarkson and Hebron stations the engines are supercharged. At Longview and Haynesville they are not but are so constructed that they can be, which would increase the brake horsepower from 800 to 1200.

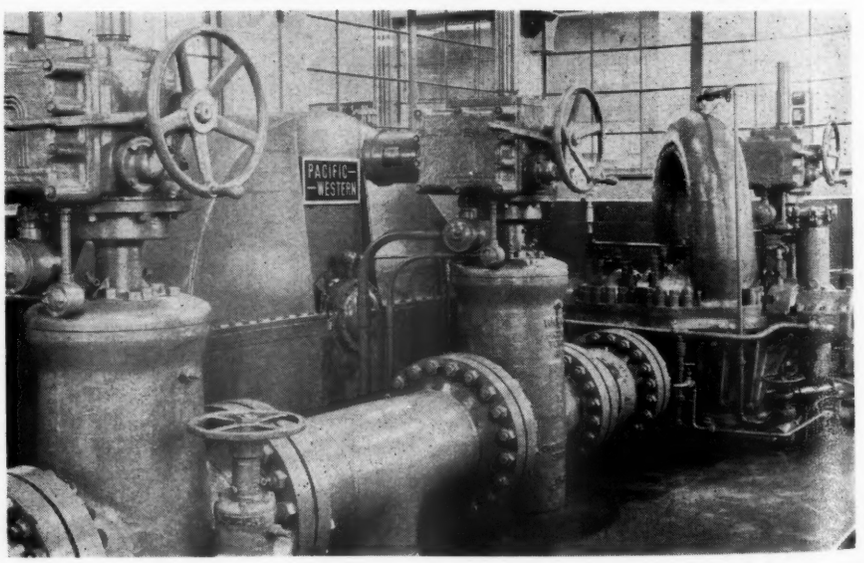
The engines are equipped with hydraulic governors. This type governor has an air-operated speed control mechanism that causes it to increase or discharge pressure on the line.

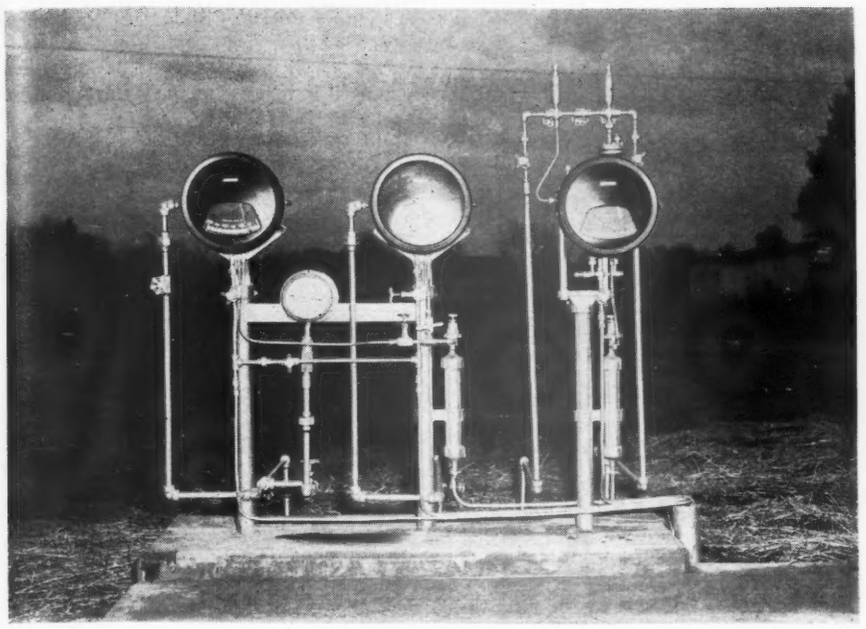
The supercharger consists essentially of a single-stage turbine wheel and a single-stage centrifugal blower impeller mounted on a common shaft, with the necessary surrounding casings. The rotor is entirely independent of the rotating parts of the engine. In operation, the exhaust gas from the engine cylinders is discharged through multiple manifolds to the turbine. The energy thus salvaged is used to drive the blower, which supplies air to the engine through the air intake manifold at a pressure above atmospheric. The compressed air does two things: (1) Scavenges the hot residue gases that otherwise would be left in the cylinder at the end of the exhaust stroke and replaces these gases with fresh air; and (2) fills the cylinder with an air charge of higher density at the end of the suction stroke. By providing this increased volume of fresh air, more of the fuel is combusted and, consequently, there is a higher output of power from the engine. The action of the turbine and blower is entirely automatic. Speed and output vary automatically and instantaneously with variations in load or speed, or both, of the engines. At full load or speed the supercharger develops 9150 rpm and approximately 50 per cent more power is developed by the engine.

At Hebron and Clarkson the dual-fuel engines are run on diesel fuel (crude oil) whereas at Longview and Haynesville they operate on 94 per cent gas and 6 per cent diesel fuel. A fuel pump supplies the injection system with fuel at controlled pressure. The desired pressure is maintained by a pressure-regulating valve situated in the fuel pump suction, and controlled by the discharge fuel pressure. By changing the relationship of the port openings in this valve, the desired operating pressure can be varied over a wide range. When a mixture of gas and diesel fuel is used, the gas is admitted into the cylinders with the intake air. The air-gas mixture entering the cylinder is ignited by the pilot (crude) oil, which is injected into the cylinder at the proper sequence by the crude fuel system described.

The engine base is of the dry type, which made it necessary to use a sump tank or reservoir in the lubricating oil system. A built-in oil pump on the engine draws the oil from the sump tank and discharges it through an oil cooler into the oil header inside the main frame. A relief valve in the pump discharge line protects the pump and system from excessive pressure and also permits by-passing the oil cooler should the cooler become clogged. A check valve in the pump suction line insures the pump retaining its prime during a shutdown period. Small quantities of oil are by-

Pump arrangement at Clarkson showing gear speed increasers and suction and discharge valves with their motor operators.





Transmitter on discharge pressure control.

Control panel for instrument that regulates station suction and discharge pressures. Clarkson station.

passed back into the sump by means of a bleeder type filter installed in the discharge line of the pump. This provides continuous filtration of the oil in the sump. Also, there is a lube oil reclaimer through which the oil passes in batches. In this reclaimer the lube oil is heated to a temperature that evaporates light ends and water, if present. A standby lube oil pump is provided in case of failure of the engine-driven pump. It is also used when an engine is being started, to circulate lubricating oil until the engine pump is operating. There are two of these standby pumps, which are rotary units having a capacity of approximately 150 gal per min and are driven by 20-hp motors.

The jacket water cooling system is of the closed type, in which water is circulated through the engine, lube oil cooler, fuel heat exchanger, and speed increaser lube cooler by motor driven centrifugal pumps. The temperature of the cooling water is governed automatically by an air-operated three-way diaphragm valve. The pumps, which are single-suction units rated at 430 gal per min, circulate the water from a standpipe or expansion tank either directly to the engines, or through the heat exchangers. Water enters the engine block through an inlet header that is situated on the exhaust side of the engine. Circulation is around the cylinder liners, then through the outside jumpers, into the cylinder head, and into the superchargers in the case of Clarkson and Hebron stations. After the water enters the cylinder heads, it circulates through all passages around the valves, etc., flows out the top and into the exhaust manifold. From here it enters an outlet header above the manifold and circulates to the system standpipe.

Gears used between prime movers and pumps to increase speed are of the single reduction type. At Longview and Haynesville the ratio is 7.95 to 1, thus requiring the driver to turn 450 rpm. At Clarkson and Hebron the ratio is 10.93 to 1, requiring the prime mover to turn 327 rpm for full speed. The Longview and Haynesville gears have a gear face width of 12.25 in., and those at Clarkson and Hebron a width of 18.15 in. The gear housing is of prefabricated steel construction, horizontal split line with the split faces accurately machined and finished to form an oil-tight seal. Pinion and shafts are an integral forging of heat-treated alloy steel. Bearings are of the horizontal split sleeve type.

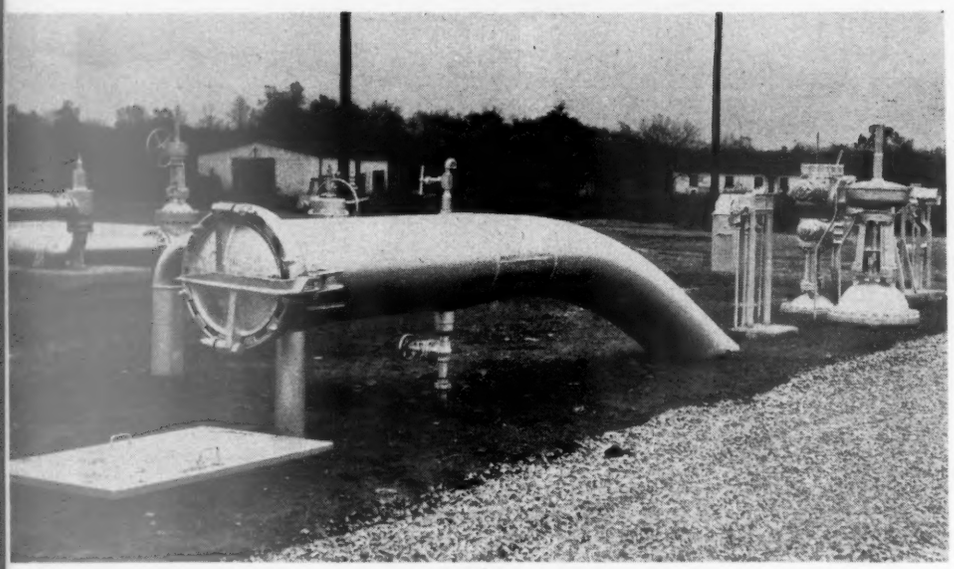
Gears and journals are pressure-lubricated by a self-contained lubrication system that consists of a sump with oil level and indicator and drain, a direct driven self-priming circulating pump, strainer, cooler, thermometer, pressure gage at pump discharge, check valve in pump suction, relief and regulating valves. The pump has a capacity of 37.6 gas per min.

For purifying the crude oil that is used as diesel fuel centrifuges have been installed.

To provide electric current at Hebron, Clarkson, Longview, and Haynesville, should there be a failure of the outside electric power, 100-kw generators have been installed. In case of such a failure, these units will be used for station lighting and for operating all auxiliaries, such as water circulating pumps, air compressors, the control desk, etc. They do not provide power for operating the booster pumps.

Motors

Motors driving the mainline pumps at Mayersville, Abbeville, and Denver are of the forced-ventilated type, rated at 1500 hp at 3600 rpm. Each motor is ventilated by a blower situated above the control room. The blowers are connected to the motors by ducts and the air, after passing through the motors, is discharged outside the station through ducts. A standby blower has been provided for use should either of the other two blowers become inoperative. The blowers can be operated from the control panel. Mercoid switches automatically operate the dampers, which are



Scraper trap at Clarkson. Bypass valves in background.

in the ducts near the blowers so that when the spare unit is used the air is automatically channeled into the correct duct. Each motor requires approximately 5300 cu ft of air per min.

An initial step in the starting procedure of one of the motors is the starting of the air blower, which takes place when the "start" button is pressed on the control desk. Ventilating air is thus forced through the ducts to the motor. The air is drawn from the outside and passes through filters before entering the blower room, from where it is forced into the ducts. These ducts are under the pump room floor and divide near the motor so that air is delivered to both ends of the motor. The air is discharged from the motor through another duct opening from the center of the motor and running under the floor to the outside of the station building. In the discharge air duct is a weighted flapper that rises when the air flow attains a safe minimum velocity. When the flapper is raised it closes a purge-time relay circuit that in turn prevents the motor circuit breaker from closing for 30 seconds. At the end of the 30 seconds the ducts and motor are free of vapors and the motor circuit breaker automatically closes, starting the motor. If the air flow stops, or the flapper is tampered with, it will drop and open the electric control circuit, causing the circuit breaker to open and shut down the motor. This action sounds an alarm and lights the indicating light on the control desk.

The motors are protected from damage by electrical devices that function when: (1) The bearings reach a temperature of 175 F; (2) there is an overload; (3) windings overheat; (4) the main power line voltage becomes too low; (5) a phase fails, and (6) there is a phase unbalance.

Controls

Automatic control instruments have been installed that serve to (1) regulate pressure, i.e., mainline pressure within the safe working limits of pipe and equipment, and (2) regulate throughput, i.e., maintain a predetermined pumping rate at all stations on the line.

The electric stations are controlled by means of a throttling valve, which is air-operated automatically from the auto-selector controller. Control of diesel stations is by means of changing the engine speed and, consequently, pump speed. This is done automatically by positioning the engine governor with the air motor, which also is operated from the auto-selector.

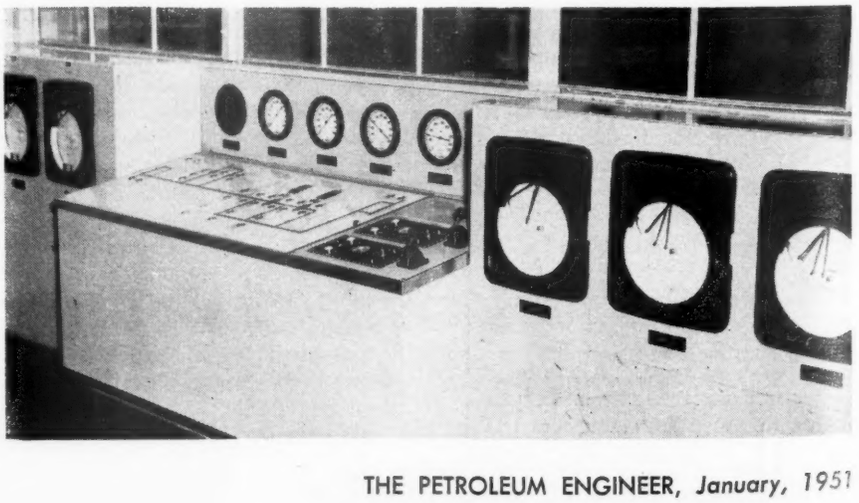
The main control system in the operation of the line consists of five types of instruments, which record the various pressures and temperatures. Their construction is such that when maximum or minimum pressures or temperatures are reached, alarms sound giving warning that operations are not normal and, in some instances, they will subsequently shut down a unit or units.

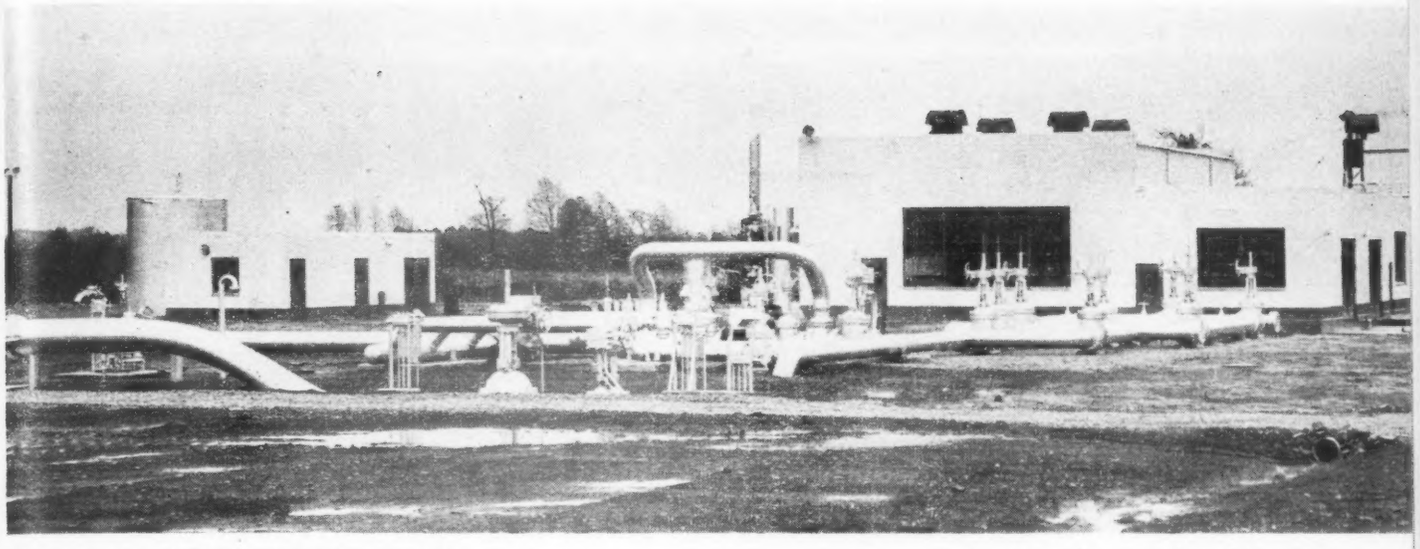
Among these instruments are the suction and discharge recorders. In addition to recording pressures, these instruments also will sound alarms at given pressures, as well as shut down the equipment if a maximum discharge or minimum suction set pressure is reached. Each instrument records on a 24-hr cycle and is equipped with four pen arms, one being the pressure indicator pen, one the high alarm pen, one the low alarm pen, and the fourth the shut-down pen. At the diesel station there is a fifth control contact, which has no pointer or pen visible, and this will change the engine speed by decreasing air pressure to an air-operated engine governor when suction pressure falls more than 3 psi below low pressure alarm setting, or when discharge pressure exceeds 3 psi above high pressure alarm setting.

The flow meter, in addition to recording the rate of flow of oil through a station, serves as an added guide in determining whether the station is operating satisfactorily. It is equipped with four pen arms, one recording flow, one indicating high and another low flow alarm setting, while the fourth indicates high flow shut-down setting.

The instrument known as the multidynalog records the temperatures of the pump case, pump, motor, and speed increaser bearings. A dynatherm resistance bulb is installed in a well at each bearing, which transmits the heat to the dynalog. When the bulb becomes heated, the resistance

Control desk at each station is central location for operations.





General view of Clarkson, Kentucky, station.

in the electrical circuit to the dynalog changes and this changes the dynalog reading. At the diesel stations the points of measurement are the inboard and outboard mainline pump bearings, inboard and outboard speed increaser pinion (high speed) shaft bearing, and inboard and outboard speed increaser (low speed) shaft bearing. At the electric stations, temperatures are measured at the inboard and outboard mainline pump bearings, pump casing, and inboard and outboard motor bearing. If the case temperature of the pump should reach 110 F, or the temperature of any of the bearings should reach 175 F, a red light will flash on at the control desk and at the same time the station alarm will sound. This instrument will not shut down the units.

To control the station suction and discharge pressure, an instrument known as an auto-selector is used. Pressure control at the electric stations is effected by increasing or decreasing the air pressure to the control valve, which is situated in the station discharge line. At the diesel stations, the auto-selector regulates the air supply to an air motor positioned engine speed regulating governor on the diesel engines. The speed of the engine can be changed in 5 minutes time from idling to full rated speed, or vice versa.

The control desk provides a central location for operation of the stations. A schematic diagram of the station piping is laid out on the top of the desk, with push buttons for operating motor-operated valves, motors, etc. Indicating lights tell the operator at a glance whether the station is operating normally. Lighted arrows in the diagram tell the direction of flow of the oil. Amber lights in the valve symbols show the valve is open, and a green light indicates it is closed. Arrow lights and valve-positioning indicating lights are controlled by limit switches on the corresponding valves through relay contacts.

The control instruments discussed and the tank gage receivers are situated on each side of the desk in full view of the operator while sitting at the desk. Immediately above the control desk are four indicating gages that show the pressures at the suction and discharge nozzles of each pump.

The control room layout at the diesel and electric stations are different in several respects and will be treated separately.

At the electric stations red lights on the control desk indicate the following: (1) Station high or low suction pressure; (2) station high or low discharge pressure; (3) individual pump high or low suction pressure; (4) individual pump high or low discharge pressure; (5) station high or low flow; (6) pump bearing temperature; (7) pump case temperature; (8) motor bearing temperature; (9) failure of air flow through either motor; (10) overcurrent, and (11) high motor winding temperature.

At the upper right section of the control desk are red lights to show the following abnormal conditions (these functions also sound a station alarm): (1) Low air pressure; (2) high sump level, and (3) control room blower.

At the extreme upper right of the control desk are three push buttons for the following functions:

1. Yellow emergency push button. This push button is of explosion-proof construction. By pressing this emergency button all electric circuits in the station are killed.

2. Below the emergency push button is a lamp test push button. When pressed this will light all lamps on the control desk for test purposes.

3. Below the emergency push button is a blue push button, which, when pressed, will silence the station alarm but will not extinguish the indicating light.

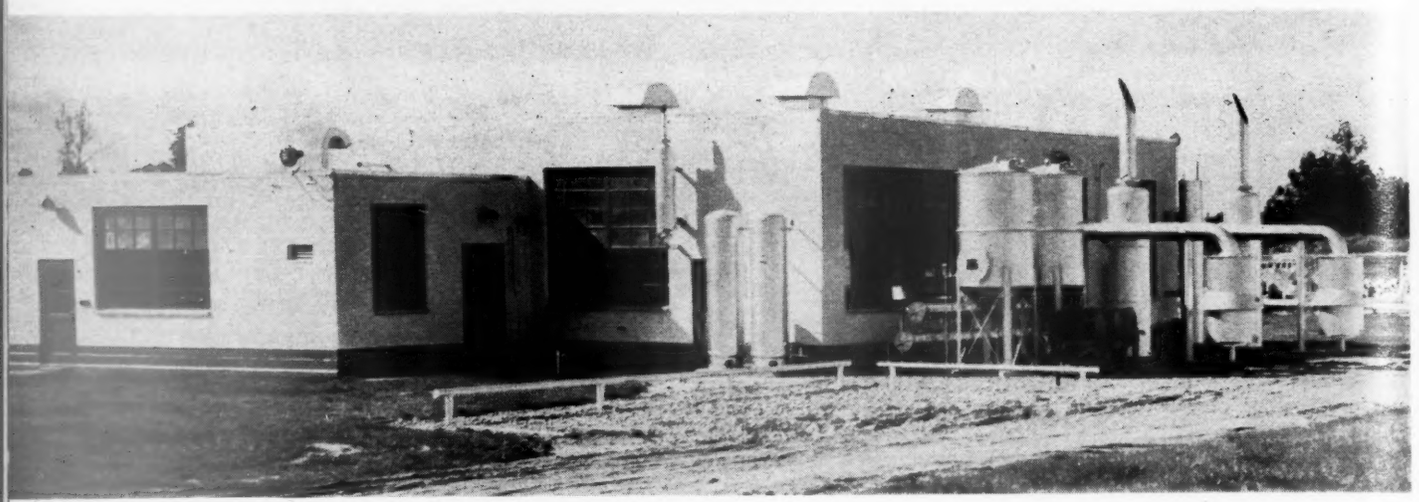
To the right of the control desk on a separate panel are the temperature recorders and the tank liquid level gages. Below the tank gages are push buttons for operating the motor-operated valves in the tank manifold. To the left of the control desk is a separate panel for the suction and discharge pressure and flow recorder.

An emergency switch is located on the outdoor switchgear to cut all electric circuits leading into the station.

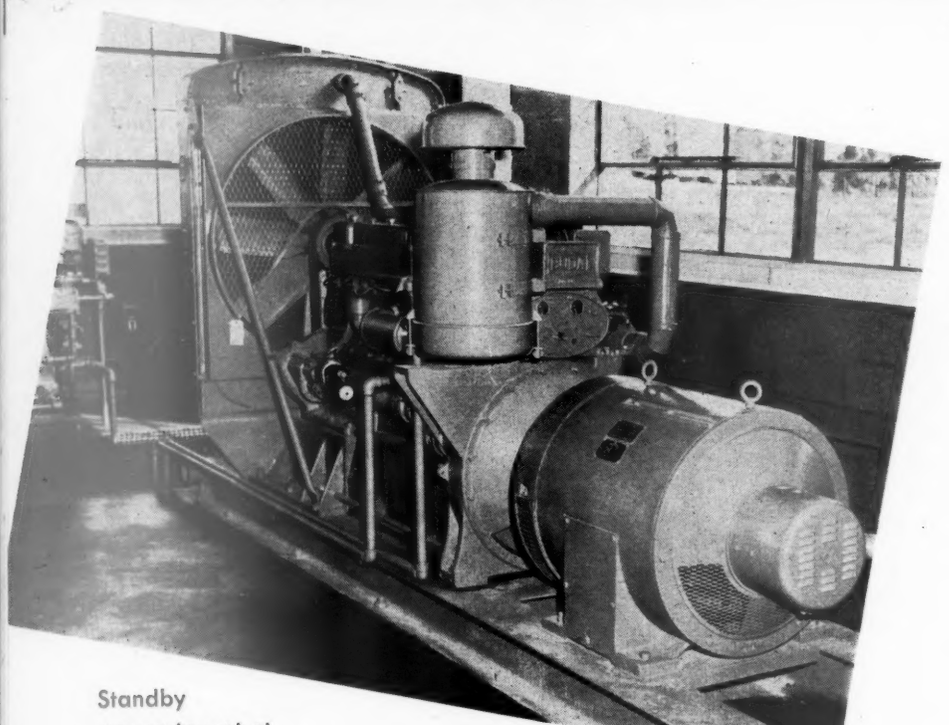
The booster pump motors are started and stopped by a push button on the control desk. The discharge valve of the large booster pump is opened and closed from the control desk. The discharge valves of the small booster pumps are operated manually, except at Haynesville and Mayersville. The discharge valves, where motor-operated, may be stopped at any desired position by pressing the "stop" push button. The booster pump suction valves are manually operated and usually are left in the open position.

At the diesel stations, red lights on the control desk indicate the following: (1) Station high or low suction pressure; (2) station high or low discharge pressure; (3) individual pump high or low suction pressure; (4) individual pump high or low discharge pressure; (5) station high or low flow; (6) engine fault; (7) pump bearing temperature, and (8) gear bearing temperature.

At the upper right section of the



Station building at Haynesville, Louisiana.



Standby generator set at Haynesville, used to provide current if outside electric power should fail.

control desk are red lights to show low station air pressure, high sump level, lamp test push buttons, and station alarm cut-out. All these functions also sound the station alarm when lights are on.

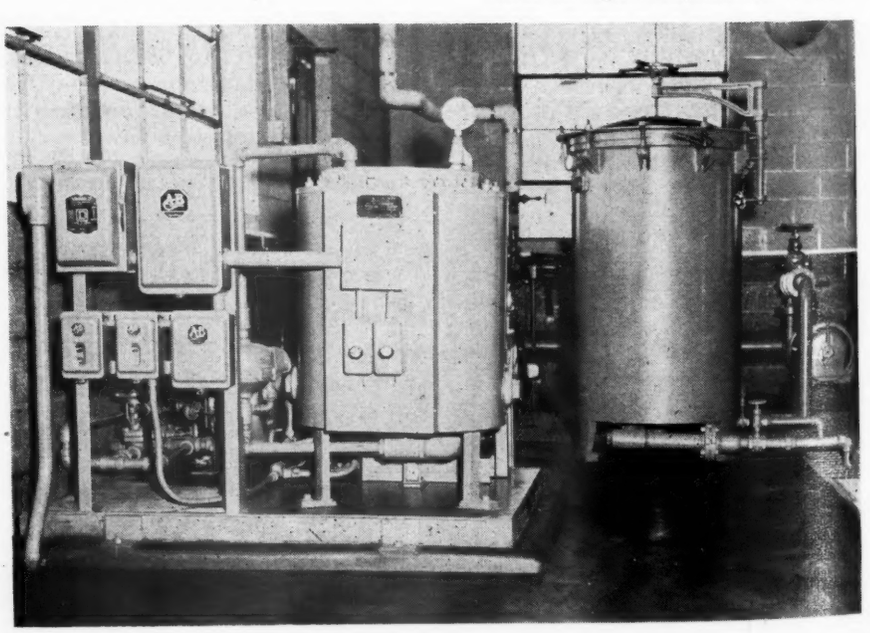
On the right side of the desk are manually operated emergency shutdown levers that serve to admit air to the engine shutdown system and remote valve controls for each engine. Also to the right of the desk, on a separate panel, are the suction and discharge pressure and flow recorders. Above these are the tank gages.

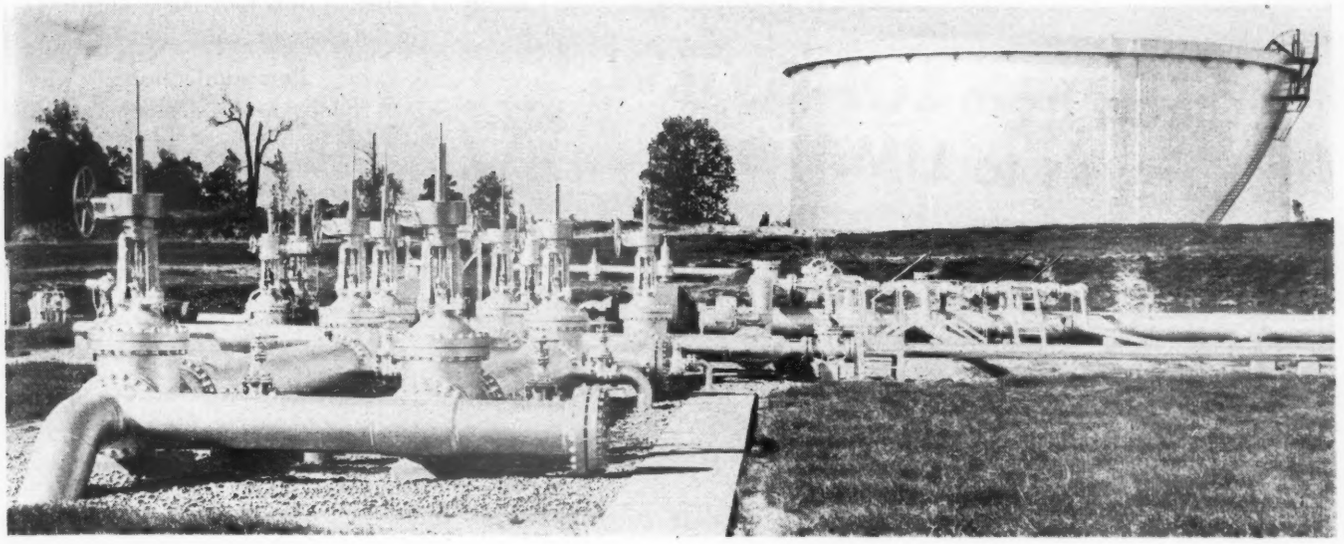
To the left of the control desk, on a separate panel, are the temperature recorders. Directly in front of the desk, and mounted on the wall, are individual pump suction and discharge pressure indicating gages.

In connection with the control instruments already discussed, each engine is equipped with an over-speed device, low lubricating oil pressure and high jacket water temperature automatic shutdown controls. In functioning, these actuate the solenoid that opens the snap action air-operated dump valve in the engine high pressure fuel system and the gas fuel engine. The gas supply to the engine is blocked, as well as the high pressure fuel dump.

Another control that functions separately is a mercoid switch that will shut down the engine by opening the dump valve in the engine fuel system and/or blocking the gas supply to the

Lube oil vaporizer at left; filter at right. Haynesville station.





Manifold at Haynesville with one of storage tanks in background.

engine, if low suction or high discharge pressures occur at the pump nozzles. This control is essentially to prevent damage to the pump after starting should the suction or discharge valves be closed.

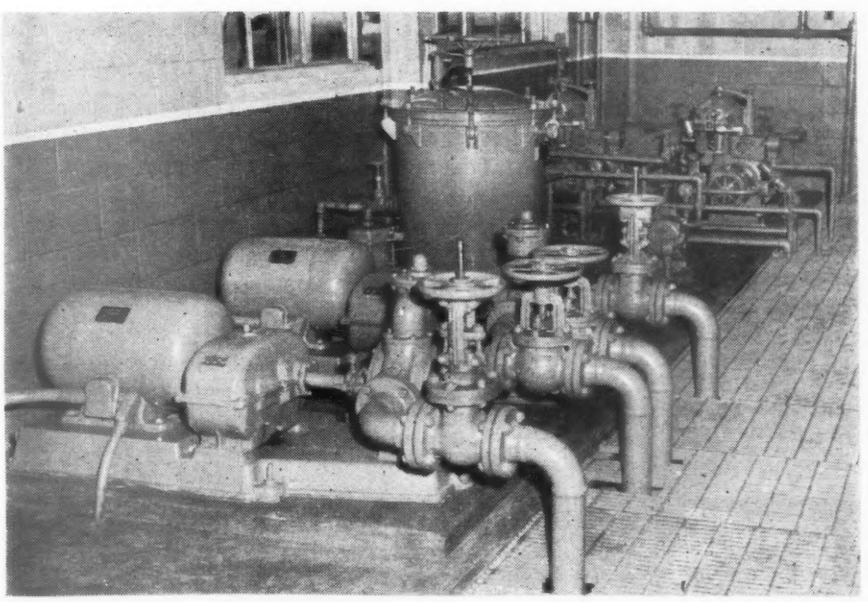
Starting the Units

In the case of the electric stations, the mainline motors can only be started from the control desk. The first operation is to turn the handle of the motor control switch to the "closed" position. This closes a pair of contacts in the motor circuit breaker. These must be closed before current can reach the electro-magnet that moves the heavy circuit breaker. The second operation is to press the "start" button on the control desk for the pump unit to be started. This energizes a starting relay, which operates switch contacts in several control circuits. Then follows a sequence of automatic operations that ends in the starting of the unit.

The diesel engines, however, can only be started from the engine control panel at the engine. Starting a diesel station differs from an electric station in that there is no automatic sequence in putting a unit on the line.

All controls necessary to bring a diesel station on the line are on the engine control panel, including motor-operated valve push buttons for all valves that need to be opened or closed during the starting or shutdown period, as well as the engine controls. Lights similar to those on the control desk indicate valve positions, whether open or closed. Pressure and temperature gages, both for line and engine functions, also are on the engine control panel. After a unit has been put on the line it can then be controlled

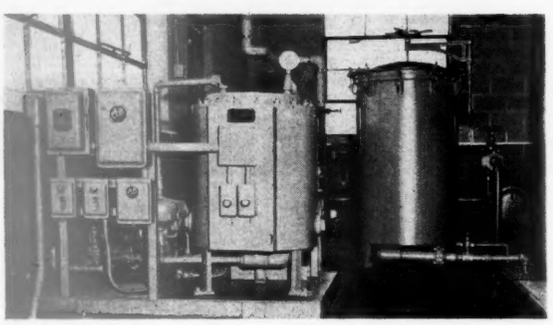
Pressure control valve, check valves, and air exhaust ducts.



Motors driving lube oil pumps, foreground. Fuel oil filter immediately behind.

Hoffman I-718-18 cartridge filters provide continuous full-flow or shunt filtration of lube oil for this and other diesel engines on the Mid-Valley line. Cover-lifting device and swing bolts speed removal of head for replacement of "throwaway" cellulose cartridges.

Lube Oil Clarity for Pump Station Diesels of Mid-Valley Pipe Line Protected by HOFFMAN Filters



Reclamation of lube oil to like-new standards is accomplished by Mid-Valley stations with Hoffman I-18-10 Vaporizers. Soluble impurities (such as light ends and water) are removed by heating lube oil, in batches, with automatic heat and flow control.

For the gas-diesel and straight diesel engines of Mid-Valley's pumping stations, 9 Hoffman cartridge Filters and 3 Vaporizers maintain lubricating oil with these advantages: The cartridge filters, directly connected to the engines and standby oil pumps, provide continuous or intermittent operation, either full flow or shunt. Hoffman's exclusive cover-lifting device and simplified swing-bolt assembly, speed replacement of 7 x 18 inch cartridges. As an adjunct, the Hoffman Vaporizer removes solubles, at full flow rates, without the high maintenance cost of centrifuges.

FREE Filtration Engineering Service

For the right answer to your filtering problems, a Hoffman filtration engineer will survey your needs — make recommendations based on detailed analysis of solutions, oils and other factors. Ask for this service — there is no obligation.

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automatically from the control desk in the control room.

Communications

A microwave system operating in the 6575-6875 mc band has been installed. There are seven circuits, one of which is a teletype circuit and one a VHF circuit for communications with radio equipped vehicles. The other five are telephone circuits with dial ringing between points.

One of the features of the system is a party line controlled by the dispatcher. The party line channel is brought into every point on the line including the main office and district offices. This arrangement is necessary because when the booster stations are installed there will be more than 20 telephones connected to this line and its unlimited use would clutter up the channel and many times would make its use by the dispatcher difficult, an obviously undesirable condition.

As electronic equipment is subject to breakdown caused by tube failure, burning out of transformers, etc., an attempt has been made to eliminate outages or breakdown insofar as possible by providing the microwave equipment in full duplicate. Thus it is possible for one of the channels to go out, but it is not likely that more than one channel will go out at any station at any time.

Station Buildings

Buildings at the electric stations are of concrete block construction to the top of the window level. The remaining parts of the walls and the roofs, which are of gable design, are corrugated asbestos. At the diesel stations the roof is flat due to the fact that the wall height required to install and repair the diesel engines would have made a gable roof undesirable in appearance.

The control room and office of each station is pressurized to a few ounces above atmospheric by an intake fan. This is important because all switchgear is housed in the control room, making it imperative to keep out any pump vapors.

Contractors

Five contractors had a part in the construction of the seven stations. Thomas Bryan and Associates built the station at Longview, Texas, and The Dresser Engineering Company the one at Haynesville, Louisiana. The Refinery Maintenance Company constructed three of the stations: Mayersville and Abbeville, Mississippi, and Denver, Tennessee. O. L. Olsen Company installed the Clarkson, Kentucky, station and Dravo Corporation the one at Hebron, Kentucky. ★ ★ ★

It walks right through with "Caterpillar" power

Working on the Inter-Provincial pipeline project in Saskatchewan, this "Caterpillar"-powered Cleveland ditcher made *5,300 FEET OF DITCH IN 12 HOURS* under varying soil conditions. In "all good" digging, actual timing has shown it making as much as 200 feet in 15 minutes.

"The 'Cat' Engine makes this a real outfit," said operator J. S. McPherson . . . which is typical of statements made by users of all types of "Caterpillar"-powered equipment. The leading manufacturers of ditching equipment are able to supply "Caterpillar" Diesels in their machines. Specify "Cat" Engines on your machinery orders and you write yourself an insurance policy for long and satisfactory machinery service. You can get this job-proved power with all types of oilfield machinery—pumps, drill rigs, compressors, excavators, generator sets, welders and all the others.

Today the importance of "Caterpillar" products, both for military use and for maintaining the national economy, is greatly increased. Talk over your machinery requirements with your "Caterpillar" dealer. He has ample parts stocks to keep your present equipment doing its job and will do his utmost to make prompt delivery of new machines.

CATERPILLAR TRACTOR CO. • PEORIA, ILLINOIS

LOOK UNDER THE HIDE

Connecting rods for "Caterpillar" Diesels are made of medium carbon steel, drop forged and heat treated. Of "H" section design, they are rifle drilled to provide oil passage to the piston pin, and to oil-cool the piston. Connecting rods are balanced to close limits. Crankpin bearings are solid aluminum alloy, precision type. Piston-pin bushings are bronze and are precision bored. Look under the hide for built-in quality.

CATERPILLAR *Oilfield Engines*

Trans-Arabian Line in Operation

World's largest oil pipe line, consisting of 1068 miles of 30 and 31-in., has an initial capacity of 300,000 bbl a day.

THE Trans-Arabian pipe line system went into operation with the loading at the Mediterranean terminal near Sidon, Lebanon, of four tankers, which took aboard a total of more than 700,000 bbl of crude oil from Saudi Arabia.

The loading and departure of the first tankers to make use of the line occurred without fanfare. Emphasis was placed upon a quick transition from construction and completion of the line to the beginning of actual deliveries.

The tankers that took the first deliveries at Sidon, saving the 7000-mile round trip that would have been necessary if they had gone to the Persian Gulf for the oil, were the *Kentucky*, *T. S. Petersen*, *Olympic Laurel*, and *Sunset*. The first three are new super-type tankers with capacities of 200,000 bbl and the *Sunset* is of the T-2 type, with a capacity of 115,000 bbl.

The 30-31 in. oil carrying system is the world's largest oil pipe line. It is 1068 miles in length and crosses Saudi Arabia, Hashimite Kingdom of Jordan, Syria, and Lebanon. Of that distance 753 miles are owned and operated by Trans-Arabian Pipe Line Company and 315 miles are owned and operated by Arabian American Oil Company.

The line, which has an initial capacity of 300,000 bbl a day, was authorized in 1947 and completed September 25, 1950. Recent weeks have been used to test the line and to accumulate storage stocks from which the first tankers were loaded.

The total amount of ocean freight hauled for construction of Tapline was approximately 3 billion ton-miles and the amount of freight hauled overland in the construction zone amounted to approximately 150 million ton-miles.

Approximately 5,000,000 bbl of oil are required to fill the line and an additional million barrels of working stocks were accumulated at the western end before the line was put into operation.

Construction of highways paralleling the pipe line and the sinking of water wells along the line have altered the living habits of nomad Arabs who formerly had to make long journeys in search of water and forage.

The 30-in. pipe was nested into the 31-in. pipe to save shipping expenses and the pipe was transported in lengths of 31 ft. An unloading terminal for pipe and supplies was built on the Persian Gulf where there were no previous facilities of any kind. The terminal became known as Ras el Mishaab. The pipe was unloaded from freighters onto a concrete island built three miles out into the Persian Gulf and transported to shore by a skyhook similar to those used by loggers in Oregon and Washington.

A preliminary estimate places the total cost of the pipe line system at $230,000,000.

W. S. S. Rodgers and Burt E. Hull, respectively chairman and president of Trans-Arabian Pipe Line Company, were at the Sidon terminal for the first loadings. Other officials there for the occasion included B. B. Howard and A. C. Long, directors and vice presidents of Trans-Arabian, and F. A. Davies, vice president. Hull, who built the Big Inch and Little Big Inch pipe lines in the United States, turned the control valve that started the flow of oil from the tank farm on the nearby Lebanese hillside to the ships moored off the coastline.

Pump Stations

A total of 40 Worthington diesel engines are involved in the system. Twenty-five of the units are 8-cylinder engines, each driving at 1710-hp a Byron Jackson single-phase centrifugal pipe line pump through Falk speed increasing gears. Fifteen are 6-cylinder engines, each driving a 900-kw electric generator. All engines are supercharged vertical, 4-cycle units. The 8-cylinder engines have a bore of 16 in., a stroke of 20 in., 350 rpm, 120 bmep. The 6-cylinder engines, a bore of 16 in., stroke 20 in., 360 rpm, 1320 bhp, and 120 bmep.

Before Worthington began the building of the engines at the Buffalo (N. Y.) Works, it assembled and installed the pilot engine at Abqaiq (Station No. 1) although it had been determined that eventually the two-stage Byron Jackson centrifugal pumps at Abqaiq would be driven by Westinghouse steam turbines. Steam at this station is required to stabilize the crude oil. At the time of the test, however, Abqaiq was headquarters for the crew, and there was an immediate need for the power. Therefore the test engine was put to use on the first available load in the area. The remaining five stations, Nariyah (No. 2), Qaisumah (No. 3), Rafha (No. 4), Badanah (No. 5), and Turaif (No. 6), are remote from large water supplies, and are all equipped with the Worthington diesel engines fueled by crude oil bled from the line and settled and filtered. The amount of crude fuel oil consumed by each engine—approximately 1500 to 2000 gal a day—is insignificant when the amount of oil handled by the pipe line is considered.

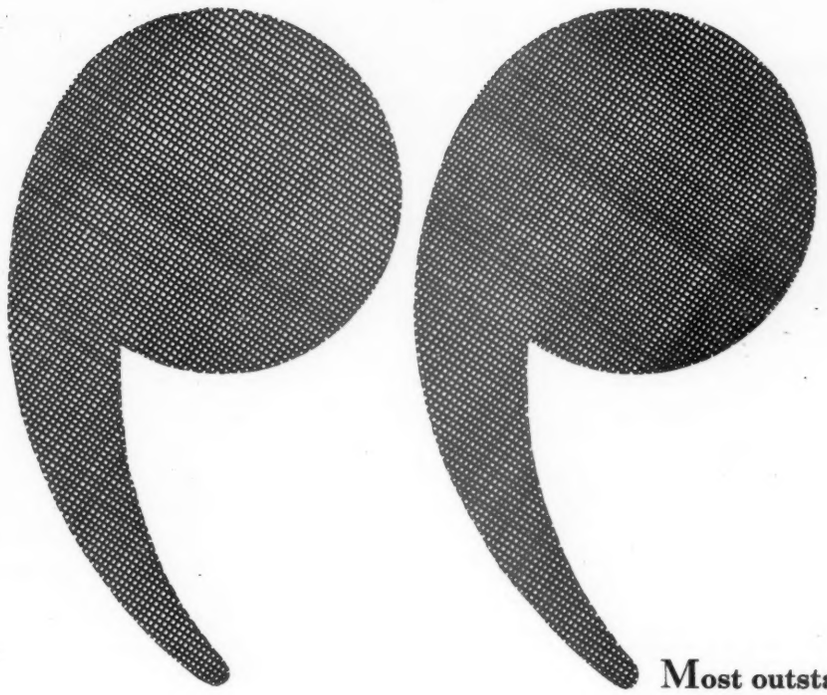
When the six stations are operating at total capacity, which is expected in January, 1951, a total of 315,000 bbl a day will be delivered. This would be 13,230,000 gal.

With the exceptions of steam-driven Abqaiq station and of Turaif where there are four engines, a total of five engines are installed at each of the other four stations for driving the pumps. Four pumps are used in series with approximately a 210 psi differential per stage, totaling approximately 840-psi discharge pressure. There is one spare unit.

Each station is approximately 180 miles from its nearest neighbor station and must therefore be a veritable community in itself. Approximately 500 individuals are employed at each of the stations at the present time, but eventually 200 to 300 persons will be sufficient to maintain normal operation—90 per cent of whom will be Saudi Arabs.

The electrical requirements of these five station communities is considerably more per capita than the average industrial-residential town in the U.S.A. The output of the two generators in regular service in each station is 1800 kw. One 900-kw unit is a spare.

A town of approximately 6000 to



Most outstanding increase in steel-making capacity in the West (since World War II) has been that of the Kaiser Fontana plant . . . ”

THAT quotation from *Iron Age*, authoritative journal of the steel industry, is confirmed by these facts:

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An important part of that increased production goes to Kaiser Steel and Basalt-Kaiser Line Pipe.

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KAISER STEEL PIPE SPECIFICATIONS • All pipe manufactured to latest A.S.T.M. and A.P.I. specifications

Type	Diameter	Length	Wall Thickness	Shipping Point
Continuous Weld—Threaded and Coupled	½" to 4" nominal I.D.	Uniform 21'	Standard	Fontana, Calif.
Continuous Weld—Plain End	2⅜" to 4½" O.D.	Up to 40'	Standard	Fontana, Calif.
Electric Resistance and Fusion Weld—Plain End	8⅝" to 22" O.D.	Up to 40'	.188" to .500"	Napa, Calif.—Basalt-Kaiser
Electric Resistance Weld—Plain End	5⅛" to 12¾" O.D.	Up to 55'	.188" to .400"	Fontana, Calif.
Electric Fusion Weld—Expanded—Plain End	24" to 30" O.D.	Up to 40'	.188" to .500"	Napa, Calif.—Basalt-Kaiser

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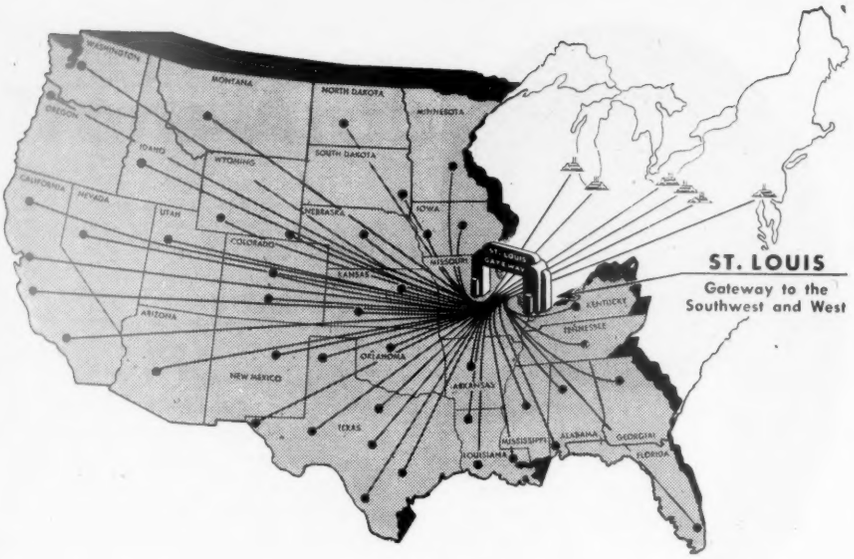

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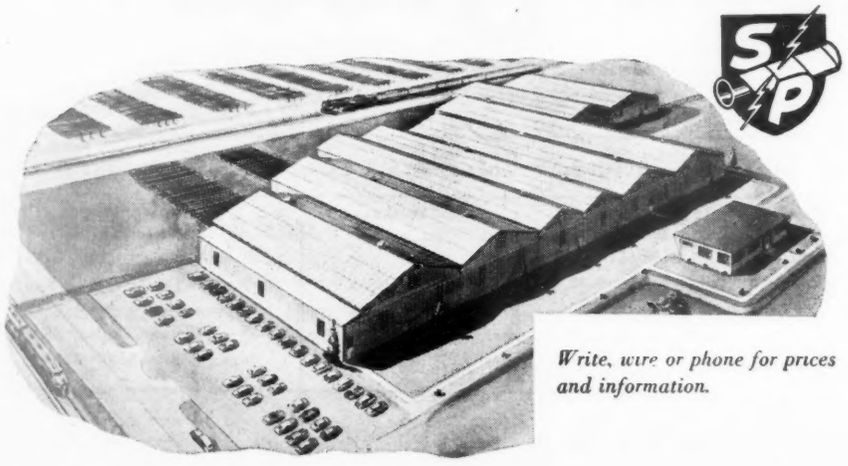

Write, wire or phone for prices and information.

7000 would normally be served for power and lighting by the 1800-kw generating station; but the electric power in the pipe line station communities serves not only the heavy industrial equipment in each area, such as auxiliary booster pumps, machine shops, welding equipment, garages, but also serves an unusually large residential air conditioning load and takes care of a modern outdoor lighting system, a clubhouse for recreation, entertainment, and church services, and a sparkling swimming pool, all part of Aramco's plan for making life comfortable and attractive for the employees who would otherwise be segregated from the comforts of the civilization they know.

A part of this plan to keep their people comfortable and happy is a complete air conditioning system that serves dwellings, offices, and all other building interiors. From a central system, chilled water is pumped through well-insulated street mains, which are branched off to each building, individually controlled. With the desert sweltering at 140 F, the ambient air temperature is approximately 125 F. while inside the buildings the temperature may be held down to between 80 and 85 F. The chilling of the water is accomplished by Worthington centrifugal refrigerating units, each rated at 500 tons, and consisting of a compressor, condenser, and cooler. A total of eight units are installed in the six stations, with additional units being installed.

To counteract the severity of the sand problem, large fans are installed in the buildings, drawing air from the outside through a water bath and producing a small positive pressure inside the building, which prevents the sand from seeping through crevices around doors, windows and other joints. The air intake for the engines is inside the building, so only clean, cooled air is used by the engine.

As Saudi Arabs are employed for not only construction work but also for some of the more responsible tasks, the gulf between races, religions, and customs is gradually being bridged. Aramco's pioneering in that direction, with a language and trade educational program, has already established certain definite patterns for mutual acceptance. The ability of the natives to learn, their quick perception of mechanical trades, and an incentive plan, indicate that eventually 90 per cent of the pipe line maintenance work will be handled by Arab employees. The Arabs already have become first class mechanics and are proving leadership abilities in handling other natives under them. * * *

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Digs

- **17′ DEEP Telescopic boom locks at 14″ depth intervals.**
- **1½′ TO 4½′ WIDE With dual booms, digs 6′ wide.**
- **8″ TO 15½′ PER MINUTE 45 digging feeds . . . 5 reverse.**

W HERE you need an extra range of digging widths and depths for biggest pipeline jobs, check Parsons 310 Trenchliner . . . the industry's largest ladder-type trencher. You get trenches up to 17 feet deep . . . 1½ to 4½ feet wide. Oversize teeth and special side-cutters provide 16 widths, with only 4 standard bucket sizes. Extra-wide boom carriage takes dual booms for trenching 6 feet wide at 11 foot depth.

Maximum digging power is transmitted by roller-chain drive direct to bucket line . . . produces 8 inches to 15½ feet of trench per minute. Selection of 45 digging feeds gives you maximum digging efficiency at any depth, width, and in all types of materials. You never need worry about overload. When heavy-duty, cast-steel digging buckets strike obstruction in trench, band-type safety clutch automatically slips over drum, dissipates any shock load.

Other production-boosting features on the big capacity 310 include: shiftable boom, digs behind either crawler . . . power-shift arc-type conveyor, shifts completely through machine in less than a minute, discharges spoil on either side. All gears, anti-friction bearings and shafts enclosed in unit-type main gear case run in continuous oil bath . . . assure long, trouble-free operation. It will pay you to get full facts. Call your Parsons oil field distributor, or send now for 310 Trenchliner bulletin.

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Interstate Commerce Commission gives such data as income, operating expenses, property investments, taxes, expenditures for new construction, etc., in its annual report on pipe lines.

Economics of the Pipe Line Industry

THE Interstate Commerce Commission has issued its annual report on crude oil and products pipe lines as of the beginning of 1950. At that time there were 124,984 miles of pipe line in operation compared with 124,092 a year previously, a gain of 892 miles. For those who will note a difference in these figures and those released by the U. S. Bureau of Mines and published in the December issue of The Petroleum Engineer (page D-9), it should be stated that the Interstate Commerce Commission figures do not include mileages of those companies operating intrastate whereas the Bureau of Mines figures do and therefore are larger. The 1950 figures, broken down, show 63,639 miles of crude oil line, 14,133 miles of products pipe line, and 47,212 miles of gathering lines.

Total investment of pipe line companies at the beginning of 1950 was $1,497,578,988. Of this total, $1,237,715,587 was invested in trunk lines, $195,693,171 in gathering lines, and $64,170,230 in general property. A year previously the total investment was $1,381,402,464. Trunk line investments showed a gain for the year of $109,739,342, gathering lines an increase of $9,187,752, and general property a decrease of $2,750,570.

Expenditures for new construction and improvements totaled $156,659,681, of which $137,729,629 was for trunk lines, $20,330,735 for gathering lines, where general property showed a reverse item of $1,400,683; however, construction work in progress amounted to $6,704,310.

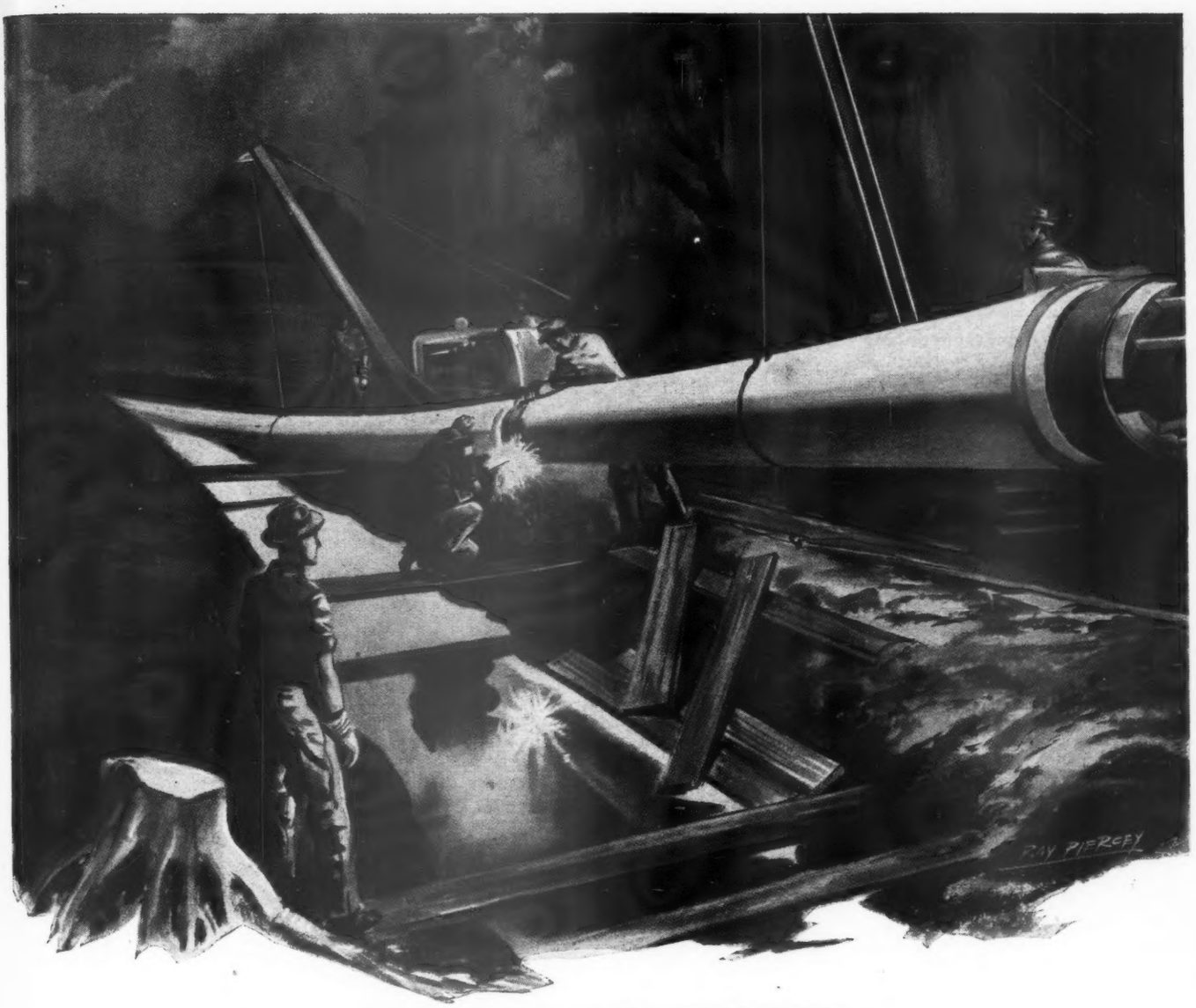
Operating revenues were off $581,907 compared with 1948; 1949 revenues totaling $376,452,116 compared with $377,034,023 the previous year. They were up almost $100,000,000 compared with 1943, however, when revenues amounted to $276,652,251. Operating expenses were down $3,602,572, more than making up for the lost revenue. Operating expenses were $249,368,200 for 1949 compared with $252,970,722 in 1948. As means of comparison with other years, operating expenses in 1943 were $148,447,937.

Taxes showed a decline in 1949, be-

TABLE 1. Income and earned surplus accounts of pipe line companies[1].

Item	1949	1948
Income statement — operating income		
Operating revenues	$293,981,390	$290,849,040
Operating expenses	189,224,789	192,631,785
Net revenue from operations	104,756,601	98,217,255
Pipe-line taxes:		
Income and excess-profits taxes	28,883,155	29,379,543
Other taxes	23,504,328	22,057,927
Total pipe-line taxes	52,387,483	51,437,470
Pipe-line operating income	52,369,118	46,779,785
Income from miscellaneous operating physical property	.....	267d
Taxes on miscellaneous operating physical property	.....	.....
Miscellaneous operating income	.....	267d
Total operating income	52,369,118	46,779,518
Other income		
Income from miscellaneous nonoperating physical property	28,315	39,021
Dividend income	391,274	258,157
Interest income	1,273,888	870,039
Income from insurance and other reserve funds	24,738	41,848
Release of premium on funded debt	.....	.....
Miscellaneous income	383,361	463,715
Delayed income credits	.....	638,426
Total other income	2,101,576	2,311,206
Total income	54,470,694	49,090,724
Miscellaneous deductions from total income		
Miscellaneous taxes	$ 107,829	$ 64,669
Miscellaneous income charges	266,945	174,068
Bad debts	10,567	31,229
Delayed income debits	.....	.....
Total miscellaneous deductions	385,341	269,966
Income available for fixed charges	54,085 353	48,820,758
Fixed charges		
Interest on long-term debt	6,038,744	3,517,433
Interest on unfunded debt	516,263	373,128
Amortization of discount on funded debt	32,131	17,627
Total fixed charges	6,587,138	3,908,188
Income after fixed charges	47,498,215	44,912,570
Contingent charges		
Contingent interest on debt	.....	.....
Net income	47,498,215	44,912,570
Disposition of net income		
Miscellaneous reservations of income	$ 2,204,872	$ 2,868,372
Stock discount extinguished through income	.....	.....
Dividend appropriations of income	14,597,945	13,644,377
Total appropriations of income	16,802,817	16,512,749
Income balance	30,695,398	28,399,821
Earned surplus statement		
Earned surplus at beginning of year	99,111,019	80,275,082
Income balance	30,695,398	28,399,821
Credits from retired carrier property	85,642	55,364
Miscellaneous credits	596,599	6,561,437
Debits from retired carrier property	8,583	29,989
Miscellaneous debits	254,464	456,067
Miscellaneous reservations of surplus	9,021,288	7,468,611
Stock discount extinguished through surplus	.....	.....
Dividend appropriations of surplus	12,073,710	8,015,555
Earned surplus at end of year	109,130,613	99,321,482

[1] See introductory statement.
d Deficit or other reverse item.



THE HEVICOTE STORY

In the swamplands of Louisiana . . . in New Jersey marshes . . . at difficult river crossings . . . and wherever a pipeline job calls for negative buoyancy and permanent protection against corrosion . . . that's where HEVICOTE is the answer.

Developed by the engineers of the H. C. Price Co., HEVICOTE was first applied in the field on the United Gas Pipe Line project near Tatum, Texas, in October, 1947. Thin-walled 20-inch pipe was given a 1¼-inch HEVICOTE application over ⅝-inch Somastic.

Subsequently, a permanent HEVICOTE plant was established at Harvey, Louisiana, and the Price Company in January, 1949, applied for a patent on a vertical method of application. This process embodies the features of uniformity and speed of application.

HEVICOTE has since been used on the Mid-Valley Pipe Line Company's Mississippi River crossing, on United Gas Pipe Line Company's Luling project, on Transcontinental Gas Pipe Line Corporation's Louisiana section, and at strategic places on other lines in the eastern United States. Pipeline engineers have praised its ease of handling under the most difficult conditions and its inexpensive solution of many field problems.

HEVICOTE is the original and best answer to the need for negative buoyancy and permanent protection.

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CONSTRUCTORS

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America's Foremost Pipeline Constructors

TABLE 2.
SUMMARY OF SELECTED FINANCIAL AND OPERATING DATA OF PIPE-LINE COMPANIES FOR THE YEARS 1943-1949[1].

ITEM	1949	1948	1947	1946	1945	1944	1943
Number of companies at close of year	73	74	71	70	74	75	74
MILEAGE OPERATED							
Gathering lines	47,212	47,036	45,909	44,862	43,994	43,276	42,471
Trunk lines	77,772	77,056	73,389	71,682	69,357	68,339	66,312
BALANCE-SHEET ITEMS							
Investment in carrier property	$1,497,578,988	$1,381,402,464	$1,225,168,434	$1,106,453,978	$1,042,522,828	$1,000,741,256	$965,464,043
Other investments	78,285,034	52,167,727	56,454,869	69,990,898	86,713,055	62,766,589	39,890,953
Cash	45,381,191	45,159,043	44,193,933	39,033,755	40,612,464	36,594,207	45,126,391
Material and supplies	38,109,334	41,382,948	32,509,860	23,370,998	21,004,827	18,912,057	17,549,499
Total current assets	175,458,317	168,020,450	126,621,264	103,818,665	115,369,824	104,149,919	107,501,243
Capital stock*	235,699,492	235,376,467	233,815,067	240,148,818	253,782,318	243,377,123	250,012,261
Funded debt unmatured*	312,953,715	203,806,644	105,543,388	57,659,257	47,430,525	39,250,628	47,053,923
Total current libilities	97,377,436	110,130,735	105,067,279	82,789,274	77,642,008	90,962,445	81,519,425
Accrued depreciation—Carrier property	623,709,410	599,893,353	573,519,643	550,765,295	527,617,747	500,534,311	475,252,176
Amortization reserve	73,051,421	73,754,252	73,603,508	71,510,994	64,721,525	48,695,296	39,612,611
Total surplus*	201,569,557	180,055,599	147,836,483	129,195,116	120,251,448	93,016,189	71,173,735
INCOME ITEMS							
Operating revenues	376,452,116	377,034,023	325,223,884	293,722,598	304,268,132	310,194,453	276,652,251
Operating expenses	249,368,200	252,970,772	214,681,999	183,869,101	191,667,755	172,367,510	148,447,937
Pipe-line taxes:							
United States Government taxes	49,074,907	52,453,499	44,369,699	43,292,770	35,729,646	60,794,752	56,402,365
Other than United States Government taxes	14,726,770	12,804,107	11,757,038	10,075,527	9,743,325	9,192,475	9,181,772
Total	63,801,677	65,257,606	56,126,737	53,368,297	45,472,971	69,987,227	65,584,137
Pipe-line operating income	63,282,239	58,805,645	54,415,148	56,485,200	67,127,406	67,839,716	62,620,177
Interest on long-term debt	6,674,285	4,057,922	2,540,335	2,349,920	2,269,076	2,475,683	2,384,193
Net income	57,743,412	56,679,058	53,144,549	56,094,398	65,940,663	65,715,492	61,302,265
Dividend appropriations:*							
From current income	14,597,945	13,644,377	9,462,899	14,999,189	14,991,137	17,513,853	16,655,130
From earned surplus	12,073,710	8,015,555	14,179,692	20,341,903	3,689,885	4,504,899	7,796,576
Total	26,671,655	21,659,932	23,642,591	35,341,092	18,681,022	22,018,752	24,451,706
Depreciation charged to operating expenses:							
Gathering lines	9,304,963	8,600,620	8,025,724	7,365,571	7,273,276	6,609,519	6,397,146
Trunk lines	42,808,274	37,873,160	34,452,758	32,820,881	44,350,642	35,377,354	32,675,666
Total	52,113,237	46,473,780	42,478,482	40,186,452	51,623,918	41,986,873	39,072,812
STATISTICS							
Oil transported:							
Number of barrels received into system:							
From connecting carriers:							
Crude oil	748,617,579	851,446,666	804,894,032	735,137,031	859,318,798	880,451,009	761,200,502
Refined oils	57,174,436	54,283,464	58,962,375	64,204,253	78,035,465	93,471,000	53,012,683
Total	805,792,015	905,730,130	863,856,389	799,341,284	937,354,263	973,922,009	814,213,185
Originated:							
Crude oil	1,414,886,575	1,586,331,016	1,431,191,245	1,318,766,572	1,291,922,201	1,277,197,360	1,122,597,403
Refined oils	240,850,328	227,480,846	186,812,885	154,118,079	149,967,062	146,967,426	143,517,434
Total	1,655,736,903	1,813,811,862	1,618,004,130	1,472,884,651	1,441,889,263	1,424,164,786	1,266,114,837
Total received into system	2,461,528,918	2,719,541,992	2,481,860,519	2,272,225,935	2,379,243,526	2,398,086,795	2,080,328,022
Oil Transported:							
Number of barrels delivered out of system:							
From connecting carriers:							
Crude oil	740,202,729	829,232,167	793,746,765	715,351,965	894,147,153	959,614,186	808,104,703
Refined oils	51,925,633	51,175,291	57,119,394	50,892,070	70,322,532	83,049,031	57,685,743
Total	792,128,362	880,407,458	850,866,159	766,244,035	964,469,685	1,042,663,217	865,790,446
Terminated:							
Crude oil	1,405,325,716	1,589,730,078	1,435,565,648	1,327,402,432	1,243,601,027	1,190,321,412	1,074,920,074
Refined oils	250,488,816	227,001,314	187,907,938	166,626,213	157,335,016	156,368,821	136,048,966
Total	1,655,814,532	1,816,731,392	1,623,473,586	1,494,028,645	1,400,936,043	1,346,690,233	1,210,969,040
Total delivered out of system	2,447,942,894	2,697,138,850	2,474,339,745	2,260,272,680	2,365,405,728	2,389,353,450	2,076,759,486
Number of barrels having trunk-line movement:							
Crude oil	1,753,996,239	1,947,066,490	1,797,969,737	1,664,599,595	1,721,440,552	1,749,577,159	1,504,076,981
Refined oils	302,588,264	280,019,453	245,161,310	217,472,898	228,226,175	251,399,847	195,906,804
Number of barrel-miles (trunk lines):							
Crude oil (thousands)	497,178,742	513,497,782	465,503,961	428,843,173	429,942,740	437,679,901	393,029,547
Refined oils (thousands)	92,562,756	85,087,129	71,554,783	58,752,072	65,360,294	70,916,543	60,896,435
EMPLOYEES							
Employees and their compensation:							
General officers and general office employees:							
Average number	2,968	2,870	2,740	2,535	2,330	2,228	2,153
Compensation	$14,100,317	$13,177,806	$11,438,245	$ 9,546,582	$ 8,308,112	$ 7,861,332	$ 7,098,359
All other employees:							
Average number	24,418	25,693	24,345	23,272	21,422	21,269	21,289
Compensation	$102,756,301	$104,903,187	$ 89,689,765	$ 74,899,674	$ 67,939,475	$ 65,702,143	$ 57,563,211
Total employees:							
Average number	27,386	28,563	27,085	25,807	23,752	23,497	23,442
Compensation	$116,856,618	$118,080,993	$101,128,010	$ 84,446,256	$ 76,247,587	$ 73,563,475	$ 64,661,570

[1] See introductory statement.

TABLE 3.
PIPE LINE MILEAGE OPERATED BY INDIVIDUAL COMPANIES.

Name of company	Grand total	Trunk Line			Gathering line, crude oil
		Total	Crude oil	Refined oils	
Total mileage operated	124,984	77,772	63,639	14,133	47,212
Ajax Pipe Line Corp.	819	819	819	...	...
American Petroleum Co.	146	75	75	...	71
Anderson-Prichard Pipe Line Corp.	114	...	...	...	114
Arkana Transit Corp.	69	35	35	...	34
Arkansas Pipeline Corp.	519[1]	277[1]	277[1]	...	242[1]
Atlantic Pipe Line Co.	2,249[2]	1,717[2]	1,712[2]	5	532
Bell General Pipe Line Co.	174	40	40	...	134
Bell Oil & Gas Co.	138	10	...	10	128
Bell-Western Corp.	51	35	35	...	16
Bradford Transit Co.	691	...	...	...	691
Buckeye Pipe Line Co.	6,010	2,938	2,745	193	3,072
Buffalo Pipe Line Corp.	161	161	...	161	...
Canadian Trunk Line	10	10	10	...	...
Cities Service Pipe Line Co.	818[3]	313[3]	313[3]	...	505[3]
Claiborne Pipeline Co.	33	33	...	33	...
Cleveland Pipe Line Co.	24	24	24	...	...
Continental Pipe Line Co.	1,931[4]	...	...	...	1,931[4]
Cooperative Refinery Assn.	986	251	250	1	735
Crown Central Pipe Line & Transporation Corp.	1	1	...	1	...
Detroit Southern Pipe Line Co.	85	85	...	85	...
Eureka Pipe Line Co.	3,822	510	510	...	3,312
Freedom-Valvoline Oil Co.	1,457	297	297	...	1,160
Globe Pipe Line Co.	7	7	7	...	...
Great Lakes Pipe Line Co.	3,090	3,090	...	3,090	...
Gulf Refining Co.	9,559	6,780	6,457	323	2,779
Humble Pipe Line Co.	9,018	5,777	5,501	276	3,241
Illinois Pipe Line Co. of Texas	108	...	...	...	108
Interstate Oil Pipe Line Co.	4,533	3,107	3,107	...	1,426
Kaw Pipe Line Co.	1,197	...	...	...	1,197
Keystone Pipe Line Co.	700	700	3	697	...
Magnolia Pipe Line Co.	8,615	5,900	5,497	403	2,715[5]
Mid-Valley Pipeline Co.[6]	12	12	12	...	...
National Transit Co.	2,976	1,144	1,133	11	1,832
New York Transit Co., Inc.	184	184	184	...	...
Northern Pipe Line Co.	624	624	624	...	...
Ohio Oil Co.	3,888	2,698	2,698	...	1,190
Ohio River Pipe Line Co.	2	2	2	...	...
Pan-Am Southern Corp.	49	...	...	...	49
Pan American Pipe Line Co.	893	436	436	...	457
Phillips Petroleum Co.	1,645[7]	1,645[7]	...	1,645[7]	...
Phillips Pipe Line Co.	1,999	1,139	1,131	8	860
Plantation Pipe Line Co.	1,261	1,261	...	1,261	...
Portland Pipe Line Corp.	173	173	173	...	...
Project Five Pipe Line Corp.	150	150	...	150	...
Pure Oil Pipe Line Co.—Penna.	45	45	45	...	...
Pure Transportation Co.	1,283	422	415	7	861
Richardson Pipe Line Co[8]	....	....	....	....	....
Rocky Mountain Pipe Line Co.	297	297	297	...	...
Salt Lake Pipe Line Co.	213	186	186	...	27
Shamrock Oil & Gas Corp.[9]	....	....	....	....	....
Shell Pipe Line Corp.	5,416[10]	4,012[10]	3,708[10]	304	1,404
Sinclair Refining Co.	13,550[10]	7,914[10]	5,274[10]	2,640	5,636
Socony-Vacuum Oil Co., Inc.—White Eagle Pipe Line Div.	119	...	...	...	119
Sohio Pipe Line Co.	2,631	1,363	1,363	...	1,268
Sohio Western Pipelines, Inc.	72	....	....	....	72
South West Pennsylvania Pipe Lines	1,668	412	412	...	1,256
Southeastern Pipe Line Co.	479	479	...	479	...
Southern Pipe Line Co.	266	266	266	...	...
Stanolind Pipe Line Co.	11,274	8,194	8,194	...	3,080
Sun Pipe Line Co.	1,232	718	718	...	514
Sunray Pipe Line Co.	84	84	...	84	...
Susquehanna Pipe Line Co.	902	902	2	900	...
Texas-Empire Pipe Line Co.	1,906	1,906	1,906	...	...
Texas-New Mexico Pipe Line Co.	2,231	1,120	1,120	...	1,111
Texas Pipe Line Co.	6,852[11]	4,109[11]	3,698[11]	411	2,743
Tidal Pipe Line Co.	186	20	20	...	166
Tide-Water Pipe Line Co., Ltd.	576	576	576	...	...
Toronto Pipe Line Co.	328	...[12]	...[12]	...	328[13]
Transit & Storage Co.	454	454	454	...	...
Triangle Pipe Line Co.	152	135	...	135	17
Tuscarora Oil Co., Ltd.	613	613	61	552	...
Utah Oil Refining Co.	896	817	817	...	79
Wyco Pipe Line Co.	268	268	...	268	...

[1] Includes 20 miles (trunk line) and 12 miles (gathering line) jointly owned with Cities Service Pipe Line Co.
[2] Includes 44 miles leased from Richardson Pipe Line Co.
[3] Excludes mileage jointly owned with other companies. See footnotes 1 and 11.
[4] Excludes 24 miles of Toronto Pipe Line Co.'s portion of jointly owned mileage.
[5] Includes 18 miles used in gathering refined oils.
[6] Report for period Sept. 21 to Dec. 31, 1949.
[7] Includes 167 miles jointly owned with Shamrock Oil & Gas Corp.
[8] Nonoperating company. Mileage leased to Atlantic Pipe Line Co.
[9] Mileage jointly owned with Phillips Petroleum Co. (acting as operator). See footnote 7.
[10] Excludes mileage jointly owned with other companies. See footnote 11.
[11] Includes 517 mileage jointly owned with Cities Service Pipe Line Co., Shell Pipe Line Corp., and Sinclair Refining Co.
[12] Excludes 13 miles not in operation.
[13] Excludes 24 miles of Continental Pipe Line Co.'s portion of jointly owned mileage and 33 miles not in operation.

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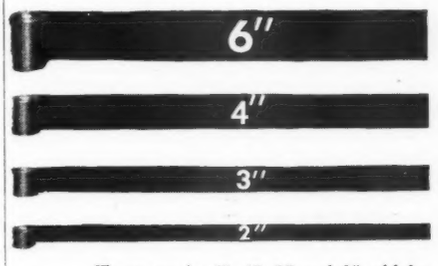

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TABLE 4.
INVESTMENT IN CARRIER PROPERTY, BY PRIMARY ACCOUNTS.

Account	Balance at beginning of year	Property changes during the year: Expenditures for new construction and improvements	Expenditures for existing property purchased or otherwise acquired	Credit	Net	Transfers, clearances, and adjustments prior years	Increase or decrease during the year	Balance at close of year
GATHERING LINES								
Land	$344,350	$ 28,861	....	$ 13,981	$ 14,880	$ 1,303	$ 16,183	$360,533
Rights-of-way	3,938,088	325,647	$ 10,380	151,798	184,229	25,522*	158,707	4,096,795
Line pipe	79,045,441	7,189,090	345,925	3,946,945	3,588,070	252,889*	3,335,181	82,380,622
Line-pipe fittings	8,044,363	1,241,893	56,469	486,833	811,529	15,191	826,720	8,871,083
Pipe-line construction	49,791,770	5,837,302	238,168	2,610,700	3,464,770	229,743*	3,235,027	53,026,797
Buildings	6,739,732	482,870	5,428	277,605	210,693	6,322	217,015	6,956,747
Boilers	36,521	14,857	....	3,617	11,240	....	11,240	47,761
Pumping equipment	16,437,301	3,347,434	84,531	1,674,934	1,757,031	58,590*	1,698,441	18,135,742
Machine tools and machinery	188,326	10,029	....	8,262	1,767	3,037*	1,270	187,056
Other station equipment	3,882,364	496,898	19,785	331,881	184,802	41,486*	143,316	4,025,680
Oil tanks	10,642,803	642,010	55,034	668,432	28,612	48,517	77,129	10,719,932
Delivery facilities	1,605,406	101,291	....	175,085	73,794*	5,032*	78,826*	1,526,580
Communication systems	2,738,023	72,331	189	194,676	122,156*	2,691	119,465*	2,618,558
Office furniture and equipment	344,345	46,898	....	19,308	27,590	12,912*	14,678	359,023
Vehicles and other work equipment	2,439,791	422,150	35,018	363,186	93,982	485,962*	391,980*	2,047,811
Other property	286,795	71,174	....	17,990	53,184	7,528*	45,656	332,451
Total	186,505,419	20,330,735	850,927	10,945,233	10,236,429	1,048,677*	9,187,752	195,693,171
TRUNK LINES								
Land	5,958,468	434,359	29,893	93,872	370,380	76,120*	294,260	6,252,728
Rights-of-way	23,614,144	1,819,800	63,934	353,376	1,530,358	85,505	1,615,863	25,230,007
Line pipe	440,633,381	48,002,655	1,282,487	9,535,961	39,749,181	114,247	39,863,428	480,496,809
Line-pipe fittings	18,730,943	4,226,178	37,950	796,408	3,467,720	91,371*	3,376,349	22,107,292
Pipe-line construction	315,099,700	44,849,503	1,411,358	6,359,583	39,901,278	100,359*	39,800,919	354,900,619
Buildings	58,032,343	6,482,693	98,715	1,359,092	5,222,316	4,419*	5,217,897	63,250,240
Boilers	558,519	9,296	....	128,717	119,421*	600	118,821*	439,698
Pumping equipment	87,518,329	8,167,849	71,472	6,719,589	1,519,732	139,310*	1,380,422	88,898,751
Machine tools and machinery	834,866	57,307	....	65,867	8,560*	4,260*	12,820*	822,046
Other station equipment	48,141,448	8,203,532	61,540	2,114,157	6,150,915	33,869	6,184,784	54,326,232
Oil tanks	85,479,779	8,790,684	173,504	2,021,118	6,943,070	51,692*	6,891,378	92,371,157
Delivery facilities	14,691,507	1,273,131	88,397	493,035	868,493	212,689	1,081,182	15,772,689
Communication systems	17,243,857	2,254,771	15,949	361,863	1,908,857	24,195*	1,884,662	19,128,519
Office furniture and equipment	1,031,557	288,235	1,322	44,137	245,420	1,295*	244,125	1,275,682
Vehicles and other work equipment	6,886,936	1,394,209	115,965	638,277	871,897	382*	871,515	7,758,451
Other property	3,520,468	1,475,427	2,367	148,729	1,329,065	164,866	1,164,199	4,684,667
Total	1,127,976,245	137,729,629	3,454,853	31,233,781	109,950,701	211,359*	109,739,342	1,237,715,587
GENERAL								
Land	250,934	4,999	....	30,080	25,081*	1,982*	27,063*	223,871
Buildings	3,771,160	3,296,404	....	152,699	3,143,705	54,966	3,198,671	6,969,831
Machine tools and machinery	536,710	76 244	....	13,363	62,881	375	63,256	599,966
Communication systems	1,367,438	376,432	....	49,045	327,387	3,996	331,383	1,698,821
Office furniture and equipment	1,811,660	257,711	573	133,755	124,529	17,501	142,030	1,953,690
Vehicles and other work equipment	5,984,450	1,265,442	45,297	874,894	435,845	433,422	869,267	6,853,717
Other property	549,781	27,631	....	8,540	19 091	8,075	27,166	576,947
Construction work in progress	51,823,311	6,704,310*	63,923	1,662,062	8,302,449*	507,548	7,794,901*	44,028,410
Unadjusted investments	2,077	635*	....	....	635*	....	635*	1,442
Acquisition adjustment	823.279	601*	440,816	41*	440,256	....	440,256	1,263,535
Total	66,920,800	1,400,683*	550,609	2,924,397	3,774,471*	1,023,901	2,750,570*	64,170,230
Grand total	1,381,402,464	156,659,681	4,856,389	45,103,411	116,412,659	236,135*	116,176,524	1,497,578,988

* Deficit or other reverse item.

ing $63,801,677 compared with $65,257,606 in 1948. Most of the taxes were paid to the United States government ($49,074,907), whereas $14,726,770 went to pay taxes other than to the U. S. government.

Net income of pipe lines was $57,743,412 in 1949 as compared with $56,679,058 for 1948, and $61,302,265 in 1943.

Dividend appropriations from current income and earned surplus totaled $26,671,655 in 1949 compared with $21,659,932 in 1948, and $24,451,706 in 1943.

Depreciation charged to operating expenses was as follows: Gathering lines, $9,304,963 in 1949 and $8,600,620 in 1948; trunk lines, $42,808,274 for 1949 and $37,873,160 for 1948. The totals are $52,113,237 for 1949 and $46,473,780 for 1948.

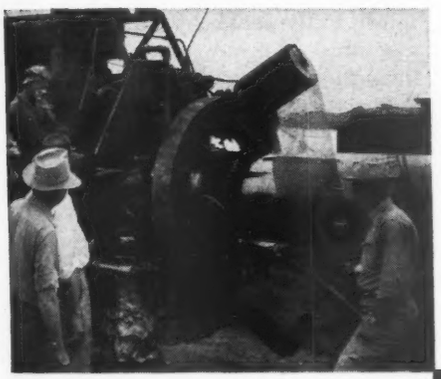
The summary and abstract of statistics issued by the Interstate Commerce Commission is the thirty-first in a series compiled from annual reports filed by certain pipe line carriers. There were 74 pipe line companies that reported to ICC for the year 1949, the same number as filed for the year 1948. Thirteen of the 74 reports received for 1949 relate to pipe line departments of large oil companies. Table 2 excludes figures for capitalization, surplus, and dividends for those companies that filed reports that relate to pipe line departments of large oil companies because such items are not segregated in the reports for the pipe line departments. All other items in Table 2 include data from a varied number of such reports, and from reports of agency operation by the Reconstruction Finance Corporation, for the years 1943 through 1949. The substitution of departmental or agency reports for corporate reports affects the comparability of items specified in Table 2 other than investment and operations for the years 1943 to 1949 and with corresponding items for earlier years.

Several of what are considered the more important tables contained in the ICC report, although all of them are important, are published herewith.

★ ★ ★

TRIPLE THREAT PROTECTION

from MIDWESTERN



MIDWESTERN continues to serve the pipeliner and the pipeline industry with its trio of great underground pipe protectors . . . COROMAT . . . KAPCO ROCK SHIELD . . . and GLASFAB. These three outstanding products, each one the BEST in its field, offer triple-threat protection against the industry's greatest enemies . . . corrosion and rock damage. As always Midwestern continues to BUILD its service to facilitate the handling of the pipeliner's problems.

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A hydrocarbon thermoplastic impregnate Fiberglas cloth, GLASFAB, with its heat and moisture resistance, high tensile strength (92 lbs. per in.) and porous characteristics, is a new and valuable addition to the pipe hand-wrapping field. Used extensively for handwrapping field joint, field repairs and for machine-wrapping on river crossings and "hot lines", GLASFAB is soft, pliable and non-irritating to the hands. Available in widths from 2 to 36" and in lengths from 150 to 2000 feet. A Midwestern brochure gives all particulars, available upon request now.

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Internal Pipe Coating Techniques*

Plastic and cement-lined coatings used in Permian Basin area for protection against corrosion by sour crude oils.

J. K. ALFRED†

INTERNAL corrosion of pipe lines is a major problem in producing areas where oils with a high content of hydrogen sulfide are prevalent. Many previous papers have discussed the mechanism of such corrosion, as well as the frequency of resultant pipe-line leaks and their staggering costs.

Other means of internal corrosion mitigation are in use, or have been tried, with various degrees of success. These include hydrogen sulfide elimination by chemical additives, oxygen reduction by tank shutoff valves, brine and water elimination by gravity settling, increased stream velocity, and regular line-scraping programs. Developments of these types are still progressing, but the most reliable means developed to date are internal linings that prevent the oil and its entrained corrosives from coming in contact with the pipe walls.

A "hot spot" for internal corrosion is the Permian Basin of West Texas, and it thus is an ideal location for the development of preventive measures. Here three methods of combating such corrosion by lining the pipe with protective coatings have caused much local interest. They are:

1. Plastic lining applied in place.
2. Cement lining applied in the mill or local plant.
3. Cement lining applied in place.

This paper aims to describe objectively the applications, and to present summaries of economic factors regarding each of these linings. All references are confined to crude oil pipe lines.

*Paper presented before American Petroleum Institute, Los Angeles, California, November 14, 1950.

†Shell Pipe Line Corporation, Colorado City, Texas.

Plastic Coating in Place

Description. The application of plastic on steel as a protective coating is not new in our industry. Most large companies have had some experience with plastic coatings on the inside of storage tanks or pressure vessels, or perhaps in pipe. Usually, however, the application has been made by brush, spray equipment, gravity flow, or dipping.

Late in 1947 a process was introduced in the Permian Basin for cleaning and coating the interior of a pipe line in place. It uses the Curtis-Tomlinson patent. The method involves the use of two double-opposed rubber plugs for the purpose of containing the cleaning medium or the plastic coating fluid in the pipe. These plugs are forced through the pipe line, at controlled speeds, by compressed air or inert gas; thus the pipe walls are cleaned by friction or pressure, and they are coated by wiping action. The assembly is shown in Fig. 1.

Each rubber plug comprises four truncated cones, two on each end, and joined in the center by a disk to make one unit. For any given pipe size, these plugs are made with their large diameters approximately ⅛ in. greater than standard inside diameter of the pipe. They are molded of first-grade neoprene, without internal reinforcement.

Other equipment required for the application includes:

1. Two portable gasoline-engine-driven air compressors, capable of delivering approximately 110 cu ft per min at 120 psi.
2. Sufficient lengths of pipe or hose to connect one compressor to each end of the section of pipe line to be coated.
3. Two loading barrels, of the same diameter as the pipe to be treated: One end of each of these has a reduced connection and a pressure-regulating valve to receive the air line, and the

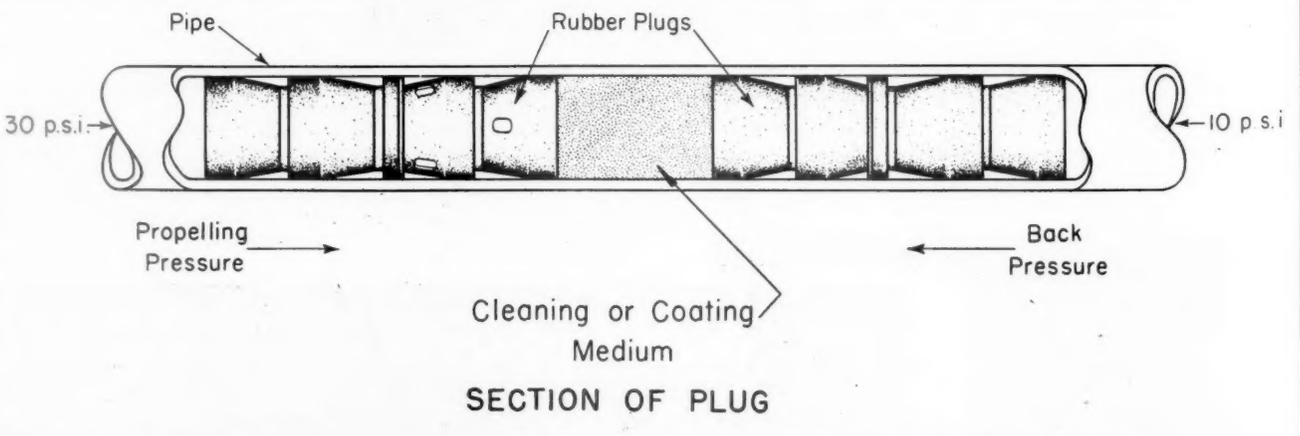

FIG. 1. Two double-opposed rubber plugs that contain cleaning material or coating plastic within the pipe.

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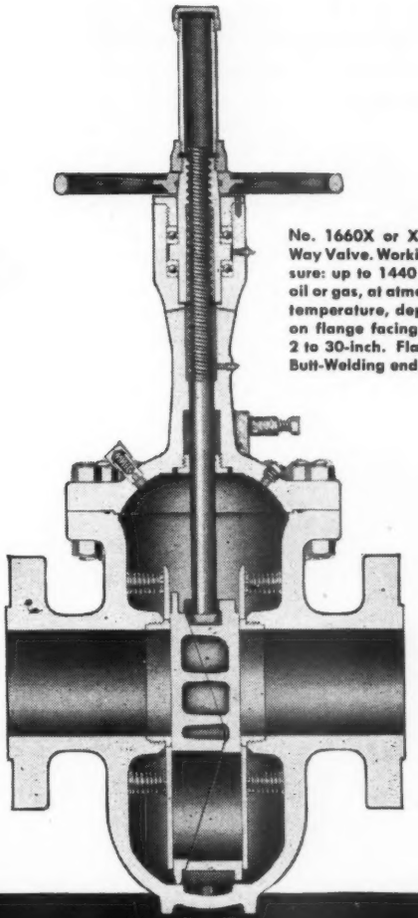
SMOOTH, CLEAR FLOW

COMPLETE GREASE SEALING

PROTECTED SEATS



No. 1660X or XH, Full-Way Valve. Working Pressure: up to 1440 pounds oil or gas, at atmospheric temperature, depending on flange facing. Sizes: 2 to 30-inch. Flanged or Butt-Welding ends.

For smoother, unrestricted flow . . . for easier, positive operation . . . these new Crane valves are outstanding performers. Developed especially for oil and gas pipe lines, they incorporate many improvements that add up to more years of maintenance-free, fully dependable service. The following are typical advantages of Crane design.

STREAMLINE FLOW—Disc ports align with seat openings to provide smooth passageway when valve is fully open. No turbulence. Least possible resistance to flow. No pockets to accumulate dirt.

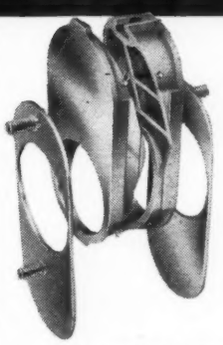
LUBRICATED WORKING PARTS. Body packed with grease to reduce friction and wear of internal parts. Grease provides seal at seats, bonnet joint, and stem, which helps maintain pressure tightness.

DUAL-SEATING DOUBLE DISC wedges tight both in fully open and closed positions. Seals off grease from line fluid; protects disc seating surfaces when valve is open.

ACCURATE DISC GUIDING assures correct seating and prevents cramping or binding the stem.

PRESSURE-TIGHT BOLTED BODY-BONNET JOINT. Line pressure forces synthetic rubber "O" ring gasket into wedge-shaped groove in body flange and helps keep the joint tight.

HOW THEY OPERATE



Double disc wedges tightly against shoulder type body seat rings in both open and closed positions. This protects seat faces from erosion and wear.

Movable spring-loaded plates, shown here, retain grease in body and bonnet while valve is being operated . . . also close "conduit" openings in disc against entrance of grease when valve is partly or fully closed.

Only one half of disc is attached to valve stem. At both ends of its travel, the unattached half of the disc comes in contact with stops. Additional wheel rotation then moves the stem-attached half of the disc farther, forcing both discs outward against seat rings and wedging them there.

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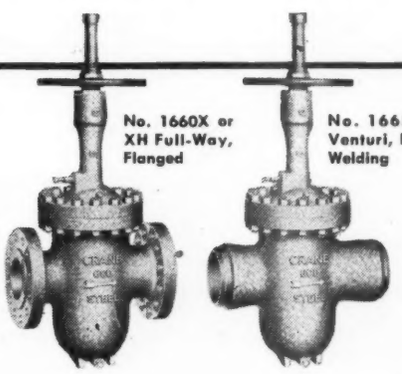

No. 1660X or XH Full-Way, Flanged

No. 1665XH Venturi, Butt-Welding

EVERYTHING FOR EVERY PIPING SYSTEM

CRANE

VALVES • FITTINGS • PIPE • PLUMBING AND HEATING

other is plain-end. These barrels also have a top connection with a combination loading-and-bleeding valve, and a pressure gage.

4. Two sleeve-type mechanical couplings capable of holding at 800-psi line pressure.

5. Miscellaneous cleaning and brushing apparatus, which will be described further in the sequence of an application.

A typical layout of this equipment, ready for operation, is shown in Fig. 2.

Air piping is connected, and one of the plugs is placed in the upstream loading barrel. In the first stage of operation, various cleaning devices are then inserted into the barrel against the first plug. The second plug is placed in the pipe, and the barrel is coupled to the pipe line and connected to one of the compressors. At the other end of the line, the downstream loading barrel is connected, and air piping is completed to the second or downstream compressor. This downstream compressor is started first, and a pressure of 10 psi to 30 psi is built up. Then the upstream compressor is started, and the same pressure is obtained in the line—thus producing a condition of equilibrium. At the downstream barrel, pressure is reduced manually through the bleeder valve; this causes the two opposed plugs to move down the pipe line, carrying their contained load of either cleaning or coating material. The rate of travel of the two plugs is controlled by the amount of pressure reduction at the lower end. When the plugs and their charge reach the downstream end, pressure is again equalized, and the direction of travel may be reversed in the cleaning operation by bleeding at the upstream end of the line.

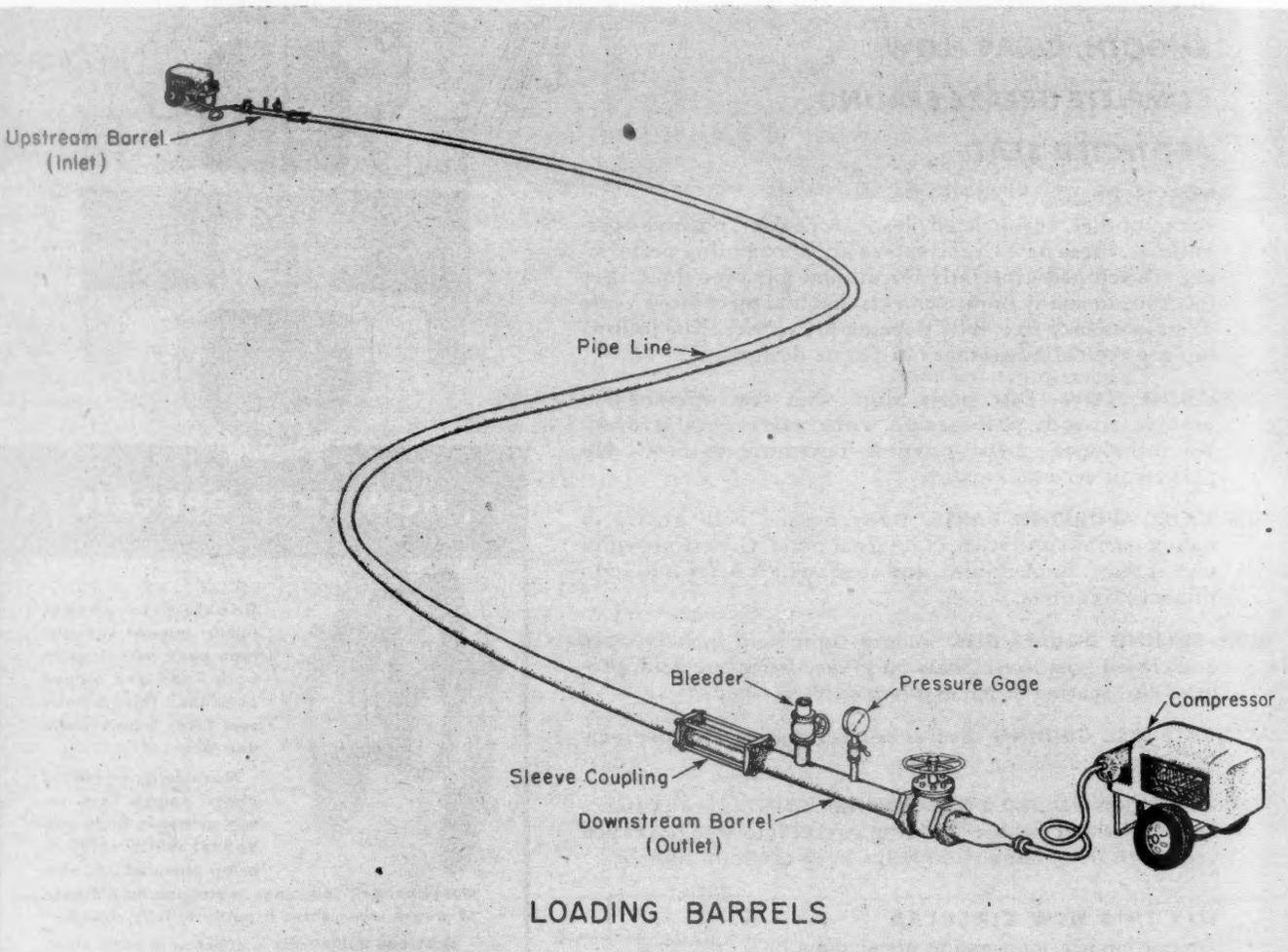

FIG. 2. A typical layout of equipment for plastic coating in place, assembled and ready to operate.

Application. One pipe line company has made a rather extensive use of this method to plastic- coat the interior of its lines in some of the most corrosive fields of the Permian Basin. This company reports the following steps as a typical application, the same being on a 4-in. medium-pressure oil-gathering line, 7400 ft long, which had been in service approximately 4 years:

1. The line was drained; then disconnected at both ends; and then turned over to the cleaning and coating contractor.

2. By the use of the loading and unloading barrels, one double-opposed plug was run through the line by compressed air to determine that it was clear and that oil pockets were emptied.

3. Another single plug, pushing circular wire brushes in front of it, was run as a preliminary cleaning operation.

4. Two plugs then were run with wire brushes, and with a cleaning solvent contained between them. This operation was reversed and repeated for a total of 6 trips.

5. Then a single plug, pushing large wads of toilet tissue, was run through. This was followed by another trip, pushing several gunney sacks. Runs pushing toilet tissue and gunney sacks were alternated seven times, with the gunney sacks wiping and the toilet tissue showing the degree of cleanliness.

6. Two plugs, with steel-lathe cut-

tings and shop-patterned scrapers contained between them, were passed slowly down the line. This process was reversed and repeated for a total of 6 trips, each taking approximately 30 min.

7. The line then was tested for leaks, with 120-psi air pressure.

8. More gunney sacks and toilet tissue were pushed alternately through for wiping and checking cleanliness. Six more trips were made.

9. Then a pretreatment of amine solution, contained between two plugs, was run to dispel moisture and to neutralize sulfur products—thus producing a paint-accepting surface.

10. A plastic prime coat was applied by containing the liquid between two plugs, with the compressor working, and with a pressure of approximately 30 psi at the upstream end. Time required was 30 min for the trip, during which 25 gal of primer were used; 4.5 gal of primer were pushed out ahead of the leading plug, through the bleeder connection at the downstream loading barrel, into a ready container. Ends of the pipe were opened, after which compressed air was blown through for 6 hr to dry the primer.

11. A plastic-finish coat then was applied in the same manner as the primer. The time required was again 30 min, during which 35 gal of vinyl plastic were used. The line was again opened, and air was blown through for 12 hr to dry the final coat. This completed the application, after which the pipe line was reconnected back into service. The total time required for the job was two days.

Although this method of applying plastic coating to the inside of pipe lines is relatively new, the company mentioned has used it to apply various vinyl and polyester plastics of its own choice. Its first line was coated about 30 months ago, and since then it has used this method of application on 12 different sections of gathering and feeder lines, including 35,523 ft of 3, 4, 6, and 12-in. pipe. With but one exception, all coating jobs have been performed on old pipe ranging from 1 to 12 years in prior service. Before a contract job is accepted, at least one inspection section of each line is cut out and examined. Whenever feasible, these sections are reset in the line with mechanical couplings so that they may be removed and inspected at regular intervals. This provides useful data on the condition of the various coatings under different services, and it also gives an indication in the event the plastic begins to fail. In this 2½-year period only one of the 12 coated sections has failed. This occurred, and was detected, during the drying operation before the line was placed in service; therefore, it was cleaned out and recoated with a different type of plastic.

Gathering lines in the sour crude district served by this pipe line company have varying service lives, some being as short as eight months. It was not uncommon to have to raise and turn some lines 90 deg after only one year's service. None of this company's lines, with plastic coated interiors applied by this process, has had a single inside corrosion leak to date.

Economic factors. Application of plastic coatings in place by this process vary in cost only slightly, depending on whether the pipe line is new or second-hand. Current quotations on average second-hand lines for cleaning and lining with one primer and one finish coat are:

Pipe size, Inches	Cost Per foot
3	$0.22
4	0.23
6	0.31
8	0.39
10	0.48

The prices include cleaning materials and customer's choice of plastics. Spot welding, patching, and other re-

pairs (if required) cost extra, and necessarily are done on a cost-plus basis.

To compare costs of this and other methods of internal lining, an actual 4-in. gathering line 7400 ft in length has been used as an example. Other prices per foot used in the coating:

Application	Cost per foot
New pipe	$0.80
Lay new pipe	0.26
Take up old pipe	0.16
Sell old pipe as junk	0.15
Sell as second-hand usable	0.40

This 7400-ft line was actually lined with plastic in 1949. In the 10 months prior to its coating, 21 leaks occurred from internal corrosion. This caused a loss of 740 bbl of oil. The cost of leak repairs, and of oil and damage losses, totaled $2898. Replacement of this line with new pipe, including take-up of the old, would have cost $9350. (No allowance is included for sale of old pipe.) To strip out, raise, and turn 180 deg would have cost $2600. The cost to apply the plastic coating in place was $1698, which, based on savings from leak reduction, and assuming no increase in leak frequency, would indicate a payout of the expenditure in 6 months.

Advantages of this method of line protection are:

1. The pipe does not need to be removed and relaid.
2. Outside protective coatings are not disturbed or damaged.
3. Damages to rights-of-way are relatively small or negligible.
4. The friction factor is improved, thus providing some increase in flow rate.

Disadvantages are:

1. The line must be taken out of service for varying lengths of time, depending on the interior condition of the pipe. It probably would not be applicable on long feeder lines without the use and added cost of a temporary bypass line.
2. A complete coating job cannot be assured in spite of frequent removal of inspection sections.
3. If compressed air is used as a driving medium, the hazard of explosion is prevalent.
4. Damage to coating may be caused later by use of plug-type scrapers.

Cement Lining

Description. Pipe with interior cement lining has been used in water lines for more than 100 years; however, in the oil industry, this span of use is hardly more than 20 years, with service principally in salt-water disposal systems and in refinery flow lines that carry highly corrosive mixtures. Relatively few crude oil gathering or feeder lines were built of cement-lined pipe prior to 1940.

Several manufacturers during the total period have produced steel or cast-iron pipe with cement linings. At least two of the larger tube mills are now marketing pipe that has such an internal coating of cement. Its use, however, requires purchase of new pipe from the mill.

In the past plants have been built to apply cement lining locally in areas of corrosive waters or oils. In the Permian Basin such a plant was erected in early 1948. It is at Odessa, Texas, which is central to the extremely "sour crude" districts. This plant does not sell pipe; but it provides labor and materials, and coats any pipe that its customers send to the plant.

Because the lining may be applied to used as well as to new pipe, an internal cleaning service is also offered by the plant. On used pipe, cleaning is accomplished by butane flame torches with extension handles, so that the hydrocarbon products are burned and scale is loosened. Pneumatic tubing rattlers knock the loosened scale

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from the pipe walls, and this scale is removed from the pipe walls by alternately swabbing and washing with water. An inspection follows, after which holes are patched or spot welded. A hydrostatic-pressure test may be applied if desired by the customer.

The materials used for the lining are essentially a mixture of first grade hydraulic cement, limestone slag, and native West Texas blow sand. These are heated separately for drying, and then are ground together in ball mills to a fineness that will pass a 70-mesh screen.

The materials are wet for mixing in batches, each batch sufficient to line one joint of pipe. The hopper of a mixing machine is loaded with the dry materials. Then—depending on the length, inside diameter, and condition of the pipe (new or used)—a predetermined volume by weight is charged to the mixer. As an example, each linear foot of standard 4-in. new pipe takes 2¼ lb of dry material; identical used pipe takes 2½ lb.

Each joint of pipe is loaded separately with the wet mixture, which contains sufficient water to allow gravity flow. The joint is capped on each end, and is hydraulically-lifted onto the rolls of a spinning machine, where with the aid of holddown idlers, it is spun at the rate of 950 surface ft per min for 1¼ min. In this operation, centrifugal force causes the solids of the mixture to take a uniform shape as a smooth, but dense, lining on the interior walls of the pipe. Joints up to 41 ft in length can be handled in this manner. After the joint has been uncapped and drained, the interior is inspected with mirrors, and each end is hand-finished. A bell-end tool produces square butted edges, which are even with the ends of the pipe.

Joints are then loaded on cars and transferred to curing kilns, where they are subjected to a 200 F steam treatment for 8 hr. The high humidity in this operation retards shrinkage and prevents cracking of the lining. Following this, the lined pipe is allowed to cure at least 24 hr in atmosphere, after which it is ready for service.

The lining thickness thus produced varies only slightly, and is nominally $\frac{3}{16}$ in. on 2, 3, or 4-in. pipe or ¼ in. on 6, 8, and 10-in. pipe. Being a continuous arch confined to the pipe walls, the lining is self-supporting; therefore, no special handling of the pipe is required other than ordinary diligence in loading and unloading—particularly the avoidance of the use of hooks in the ends of the joints.

Application. Several pipe line companies are now having pipe from their own stocks coated in this local plant, in the specific sizes and amounts required to fit various jobs, large or small. Plain-end as well as thread-and-coupled pipe is processed as requested.

In laying thread-and-coupled pipe, an overlapping plastic sleeve and a sealing compound are generally used. Plain-end pipe, beveled for welding, is joined in several ways. One company uses a ⅛-in. asbestos gasket, precut to fit the inside diameter of the lined pipe and the lip of the beveled end. Just prior to line-up of the pipe, the gasket is set in place with undiluted sodium silicate (water glass) applied to both faces of the material. During the welding operation the transfer of heat is minimized, and the sodium silicate forms a corrosion-resistant glazed surface on the interior walls. Welds cut from cement-lined pipe joined in this way indicate well-sealed interior joints, and no damage to the lining. Another company tightly butts the joints together, without standard spacing, and it runs the stringer bead in, using a ⅛-in. or smaller rod. This company also has cut test welds for examination, and it reports no damage to the lining.

Field bends of such cement-lined

HOUSTON CONTRACTING COMPANY

2707 Ferndale Place
HOUSTON 6, TEXAS

Latex Construction Company, heretofore engaged in pipe line construction, is now being liquidated and will no longer be active.

Messrs. Laurence H. Favrot and R. P. Gregory have formed a partnership under the name of Houston Contracting Company for carrying on general pipe line and allied construction work, and solicit an opportunity to bid on such work.

Mr. Geo. A. Peterkin will be associated with the new firm.

Mr. J. W. Sharman has decided to retire from this line of business.

December 1, 1950

pipe are restricted to 10 deg in 20 ft. Sharper curvature requires the use of fabricated bends, which can also be obtained with cement linings applied by hand methods. From current experience, contract costs of laying cement-lined pipe are seldom more than 5 per cent additional to the cost of laying unlined pipe.

In a small trunk line, one company has installed 120,000 ft of such cement-lined pipe, ranging in size from 6⅝ in. to 8⅝ in. in outside diameter. This line serves one of the sourest crude fields of the Permian Basin, and operates at pressures up to 950 psi. The line was originally laid of plain steel pipe in 1937. Cement-lined pipe has been laid as a replacement in 5 increments since 1942 — some in sections that had been replaced one or more times previously with plain steel pipe. Only the first increments were laid with pipe that had the lining in place when purchased from the mill. Prior to the laying of the cement-lined pipe, a total of 788 leaks occurred in these 5 sections. No leaks have developed to date in the cement-lined pipe, some of which has been in service as long as 8 years.

This same pipe line company has installed 35,900 ft of such cement-lined pipe as replacements for 4, 6, and 10 in. steel pipe in gathering systems. Service of the cement-lined sections varies from 8 months to 7½ years; and, although 455 leaks were experienced in the plain steel pipe, none has developed in the cement-lined replacement sections. Another pipe line company in this area has installed 121,000 ft of cement-lined pipe in its gathering systems, with excellent results in eliminating internal corrosion problems.

Economic factors. The fact that any amount of either new or second-hand pipe can now be cement-lined locally in the Permian Basin has increased the use of this means of controlling internal corrosion of pipe lines. Quotations for this lining service at the plant in Odessa are:

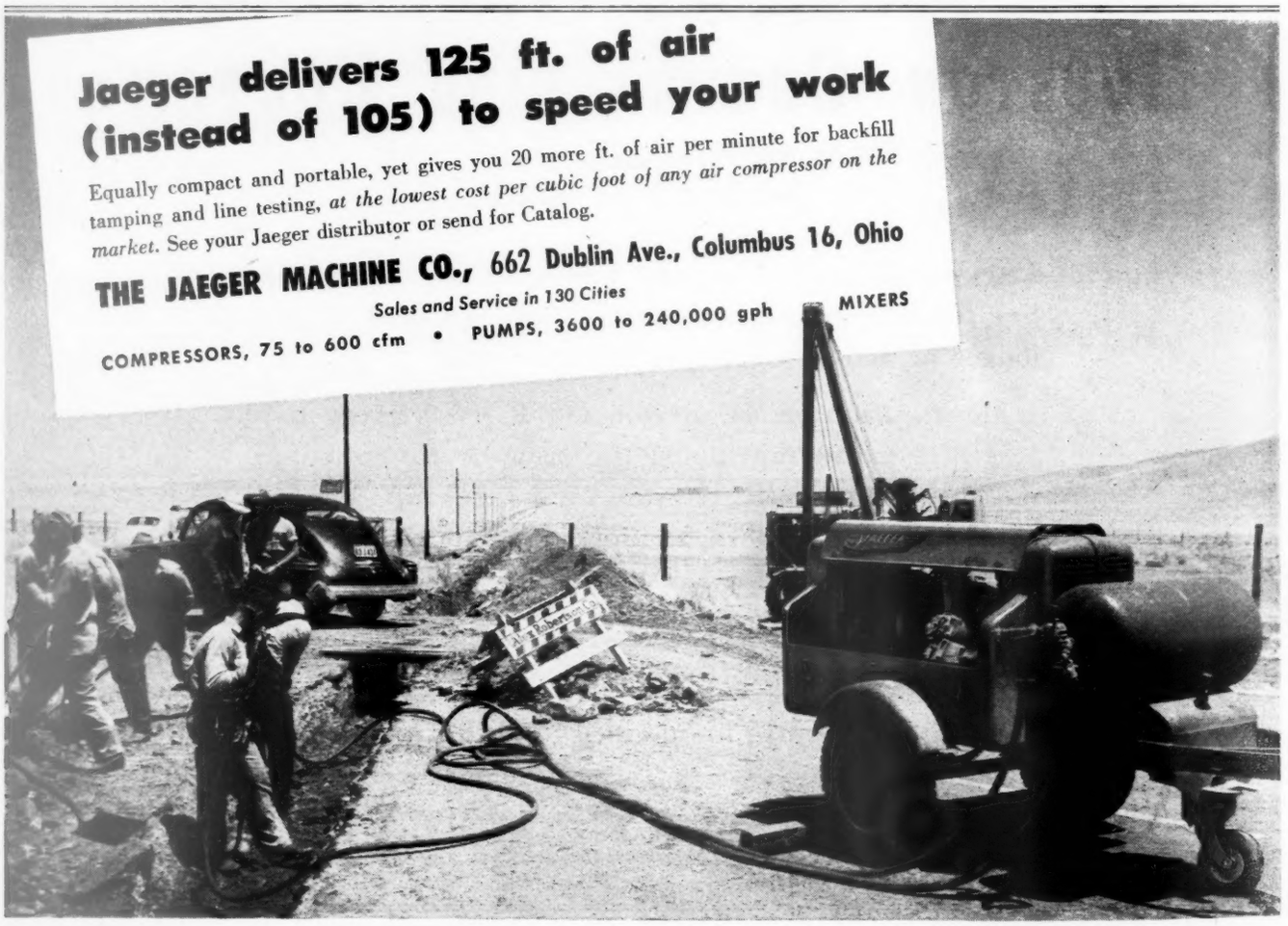
Pipe size, inches	Cost per foot
2	$0.20
3	0.25
4	0.35
6	0.60
8	0.70

(Jobs more than 10,000 ft in length receive a 10-per cent discount. If the pipe is second-hand, patching and repairs are done on a force-account basis.)

Consider again the 7400-ft section of 4-in. gathering line, cited under "plastic coating," which had a cost of $2898 for oil loss, damage, and repairs within 10 months. Cement lining, at the local plant, of pipe equally as good as that to be removed would cost $2590, and laying costs would amount to $1990. If the expense of taking up and cleaning the old line and turning it to stock in place of the newly lined pipe is added, we get a total of $5910 for replacing the plain steel with cement-lined pipe. Again assuming no increase in leak frequency, the savings in "leak expense eliminated" would pay out the cost of cement-lined pipe in 20 months. This figure applies regardless of whether the original pipe is cleaned and coated at the plant and then relaid, or whether other second-hand pipe is coated and laid, after which the original pipe is cleaned and returned to second-hand stock. Of course, the latter is the only means by which an extended service interruption can be avoided.

Advantages of plant-coat cement-lined pipe are:

1. By visual inspection, assurance is given that the coating is complete.
2. There is little doubt that the life of the coated line will be 5 to 8 years or longer.
3. No chance exists for fire or explosion as compared to other internal coatings.
4. There is no limitation to operating pressures other than the standards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for the particular quality and thickness of pipe that bears the internal coating.

5. No appreciable losses result from operational downtime while cement coating is applied.

Disadvantages are:

1. Construction damages will accrue because of laying and taking up of pipe.
2. Previous external coatings are destroyed.
3. Slightly higher laying costs are involved.
4. Salvage of welded lines that have a cement lining would require higher takeup cost and would result in appreciable loss of inside coating.
5. Additional cost of fittings is required in place of ordinary field bends.
6. Reduction in effective inside diameter might be so critical as to require the use of the next larger size of pipe.

Cement Lining in Place

Description. Pipe has been internally coated in place with cement for 30 years or longer. This process had its inception on municipal water lines, where the cost of replacement or reconditioning of large mains or service laterals was almost prohibitive because of the location of buildings or other permanent structures. Its application to oil pipe lines is quite new. The process is covered by an Australian patent, and an oil tanker unloading line is reported to have been concrete-lined in the port of Sidney.

A firm performed the first internal coating job of this nature in the Permian Basin for one of the pipe line companies. Basically, the process consists of applying a relatively dry cement-sand mortar to the interior walls of the pipe. This is done by using a bullet-shaped mandrel with its large diameter of such size that the shape of the lining will conform to the thickness requested by the customer. This application is made on short sections of the line, approximately 400 ft in length, with the mandrel drawn through the sections by cables attached to truck winches. Interior cleaning, prior to the placing of the lining, is accomplished by cable-drawn rubber disks and steel scrapers.

Application. The 24-mile length of crude oil line that was coated in place in this manner during mid-1949 is a 10¾-in. main gravity-feeder in Lea County, New Mexico. Both new and second-hand pipe of 3 different wall thicknesses is included in this electric-welded line, laid originally in 1940.

Inasmuch as it was estimated that 90 days would be required to coat the line in place, a 2-mile temporary loop of 8-in. line was laid on top of the ground. This was placed in service to free the 10-in. line for contractor's work. Throughout the entire job it was necessary to move this 8-in. bypass 2 miles ahead and tie it into service; then to take the 10-in. line out of service long enough to drain it, tie in the 2-mile coated section from the rear, and reconnect the loop ahead. As the work progressed, each 2-mile section of 10-in. line was cut into 400-ft lengths for a "pull."

A typical operation of cleaning and lining one of these lengths was begun by excavating; then cutting a 6-ft piece from each of the ends. A ¾-in. cable was threaded through the section with the use of oil-well sucker rods. This cable was attached to several rubber "squee-gee" disks, which were slightly oversize to the inside diameter of the pipe, and to spring-steel gang scrapers. This apparatus (Fig. 3) was repeatedly pulled through the pipe line by a truck winch until neither fluid nor scale discharged.

The lining material, composed of washed sand and common portland cement, was mixed by hand in an ordinary mortar box. The sand was of two grades (fineness not disclosed), and was shipped in from the Pacific Coast in paper bags—thus making it more costly than the cement. Only sufficient water was used to make the mix fluid. No slump tests were taken.

A long-radius elbow, fixed to a vertical section of 10-in. pipe approximately 8 ft long, was set in place and coupled to one open end of the line. A free baffle in the form of a rubber disk, oversize to the inside diameter of the pipe, was threaded loosely on the "pull cable." Mortar was then loaded through the "gooseneck" into the line. This is shown in Fig. 4. The weight of the mix packed the mortar tightly against the baffle. With the lining charge completed, the "gooseneck" was dropped from the end of the pipe and the mandrel was connected to the end of the cable (Fig. 4).

This projectile-shaped mandrel, approximately 30 in. long, was tapered with guides for centering it within the pipe. The rear 12-in. were cylindrically shaped of a diameter to form a $\frac{5}{16}$-in.-thick cement coating on the pipe walls. This section was perforated; thus the water in the mortar was pressed out and allowed to settle in the bottom of the line. No means of water removal was provided; thus a cement laitance approximately ⅝-in. thick was formed in the bottom of the pipe.

A truck winch pulled the charge and the coating devices down the line at the rate of about 20 ft per min. The loose baffle forced the mortar against the mandrel, which lined the pipe to the desired thickness. Upon completion of the pull, the entire length was inspected by mirrors for imperfections; then capped for a 48-hr minimum curing period.

Each of the 400-ft sections was connected by welding in a prelined "pup" joint. Hand holes, 6 in. in diam, were left open in the top of

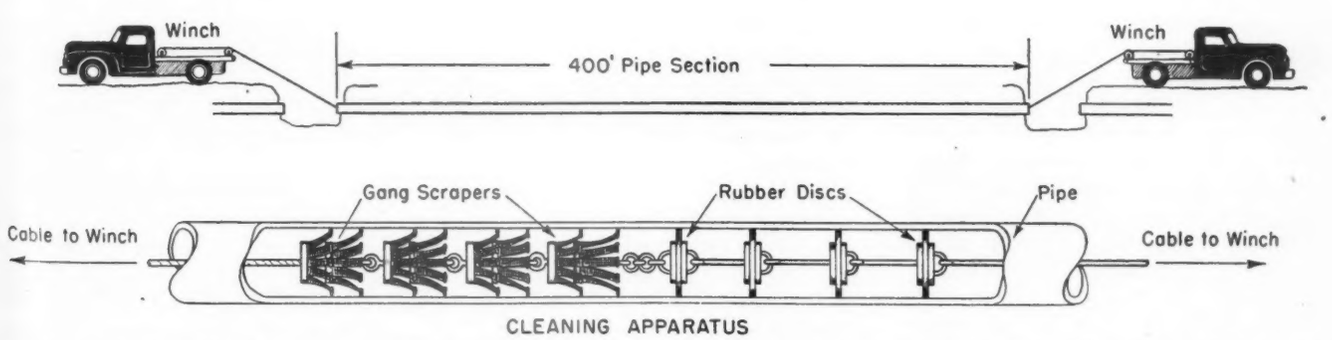

FIG. 3. Wiping disks and scraper attached to "pull cable" for cleaning interior of pipe line prior to cement-lining in place.

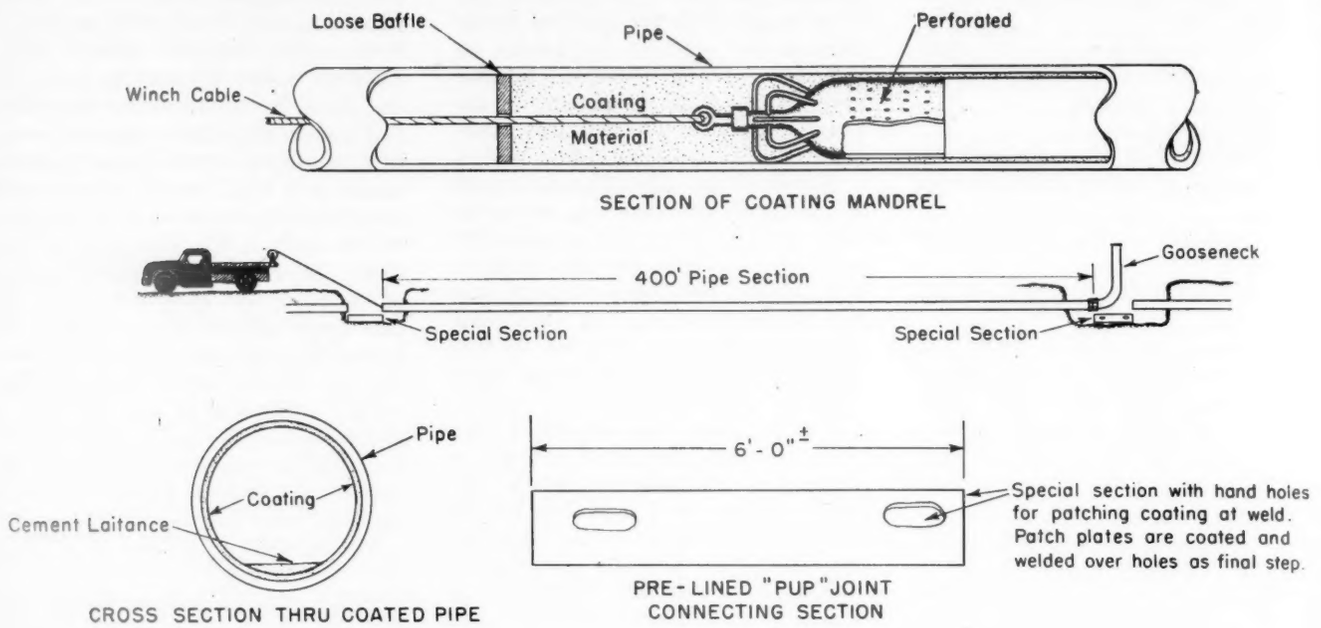

FIG. 4. A typical 400-ft pipe section showing the cement line in place.

each end of these short joints and, after welding, the interior area around the weld was hand-coated with mortar. A patch plate, 12 in. in diam. with its underside treated with coal tar, was then welded over each hole.

This was the operation progressively followed throughout the entire cement-lining job. Work was begun in May, 1949, and was completed the following August. Because of difficulties encountered, progress varied considerably but it averaged 2000 ft per day. Random test sections were cut from the line by the owner. All were satisfactory with respect to cement coverage and uniformity of the thickness, as well as to smoothness of the surface.

Although many corrosion holes were apparent in the line after it had been cleaned, others were purposely made to test the action of the lining under this condition. The result was complete penetration of the holes by the mortar and sealing of the holes satisfactorily for gravity flow-line pressures. Prior to this coating job, oil leaks were numerous in the bottom half of this line. A series of inside-diameter measurements taken during the progress of the work indicated metal losses up to 75 per cent of the original pipe-wall thickness, and not uniformly in the bottom quadrant. Today, after one year in operation, no leaks have been experienced.

Economic factors. Current quoted prices on cement lining of oil pipe lines in place, including cleaning, are:

Pipe size, inches	Cost per foot
4	$0.82
6	1.06
10	1.50

If a bypass line is required, this must be provided at the customer's expense.

For comparison, the example used under plastic coatings in place is taken again to indicate profitability. This 4-in. gravity line, 7400 ft in length, cost $2898 for oil loss and for leak repair during 10 months. The cost of cement-lining it in place would have been $6068, which would appear to pay out in 21 months because of savings in leak costs. These figures are based on the assumption that no bypass line would be required for an approximate four-day shutdown of the line.

Advantages of cement-lining pipe in place are:

1. The line does not require taking up and relaying.
2. Exterior protective coatings are not damaged, because the line is not disturbed.
3. Damage to property owners is relatively small.

Disdvantages are:

1. Assurance cannot be obtained that the pipe has been coated without imperfections.
2. Line operations would be limited to minimum pressures because of mortar-filled holes.
3. Downtime and coating costs would be increased in rough or uneven terrain.
4. Reduction of internal area of the pipe, including cement-laitance deposit, might be so critical as to eleminate this method.
5. Amount of downtime required might also be critical enough to eliminate this process.

Summary

In summary, it is the general opinion of those pipe line operators who were contacted in the preparation of this report that, in the most corrosive fields, any interior coatings that will last two years or longer are profitable on gathering and feeder lines. Further, they agree that it is more economical to utilize available coatings for these locations than to await development of other processes that may eliminate internal corrosion in pipe lines. With the prospect ahead of another period of shortage of tubular goods, much line pipe can be reused over and again by the application of inside coating of the owner's choice.

Acknowledgment

Appreciation is expressed to the following groups which furnished the information for the paper: Humble Pipe Line Company; The Texas-New Mexico Pipe Line Company; Permian Enterprises, Inc.; Curtis-Tomlinson Company, and Shell Pipe Line Corporation.

* * *

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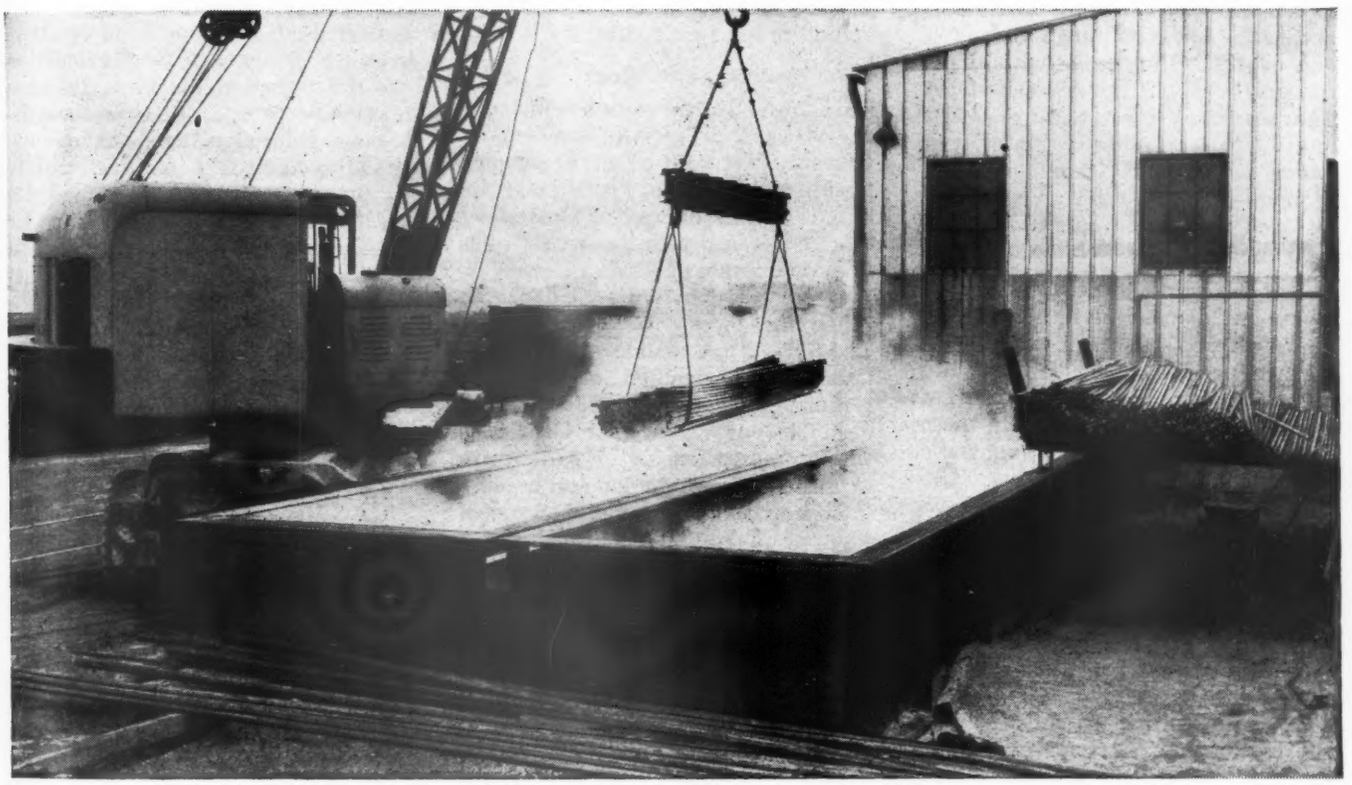

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Removal of Nitrogen From Natural Gas*

P. V. MULLINS†

NATURAL gas from certain sources contains appreciable quantities of nitrogen. The nitrogen is valueless as fuel and its presence in excessive amounts — normally defined at about 10 per cent or more—may interfere with ready marketability of the gas, limit the permissible recovery of liquefied petroleum products for separate sale, and constitute a restrictive and expensive burden to natural gas transmission and distributor systems. The research project on nitrogen removal has as its objective the investigation and possible development of economical means for removal of nitrogen from these natural gases at their sources in the field.

The principal benefit to be derived from development of means for removal of excess nitrogen would be to make it possible to increase the Btu deliverability of certain long gas transmission lines, particularly those originating in the Texas Panhandle and Hugoton gas fields of Texas, Oklahoma, and Kansas. Natural gas from these sources contains an average of 10-15 per cent nitrogen, and more in certain parts of the fields. Removal of nitrogen from natural gas at its source would increase the useful capacity of gas transmission lines by eliminating the useless volume formerly occupied by nitrogen and would so improve the flow characteristics of the gas that removal of 10-15 per cent nitrogen would result in a net increase of 20-30 per cent in the Btu deliverability of the pipe lines.

Removal of nitrogen would increase permissible recovery of liquefied petroleum gas products for separate sale without objectionable reduction in the heating value of the gas. Considerable interest was shown in this feature in earlier stages of the problem, but has diminished greatly with reduction in the market prices of LPG products.

The problem is significant also because of some general interest in large-scale gas separation methods for a variety of potential applications, as for example, the separation of ethane from natural gas.

The Bureau of Mines has a definite interest in the subject because helium-bearing natural gases processed by the Bureau for helium recovery commonly contain appreciable quantities of nitrogen, which, in some instances, present objectionable features in helium production operations.

Scope of Work

The investigative work has included a review of prospective gas separation methods that might be applied for nitrogen removal. From the beginning, the chief interest of most all of those concerned with the problem has been in the possible use of liquefaction and fractionation as it appeared to be the most favorable prospect. The Bureau has conducted pilot plant tests of this method at its Exell Helium Plant near Amarillo. The decision to engage in pilot plant tests was prompted largely by a desire to expedite the investigation and because it appeared that the major problem was one of applying the method for this particular purpose. The tests also provided an opportunity to obtain considerable fundamental data of a practical nature for possible use in engineering design, construction, and operation of a commercial plant of this type. In addition to the pilot plant tests, the work has included a review and investigation of various gas separation methods, and a review of literature and patent records pertinent to the subject.

Developments

Work on the problem was begun early in 1947. A report on the economic benefits of nitrogen removal was presented to and published by the Natural Gas Department of the American Gas Association in 1948. From a generalized relationship, applicable to typical conditions, it was concluded that the increased Btu deliverability of pipe lines from removal of 10 to 15 per cent nitrogen might reasonably justify a total expenditure of 2 to 2½ cents per M cu ft of gas processed where the gas was transported 1000 miles or more. It was emphasized that all gas sales would need to be made on a Btu or therm basis to obtain the benefits of nitrogen removal. In general, no allowance was provided for increased profits from greater permissible recovery of LPG products because of the uncertainty in market predictions.

The review of gas separation methods disclosed no fully developed commercial method for the purpose, but indicated at the time that low-temperature processing by liquefaction and fractionation appeared to be a reasonable prospect and the most favorable. Pilot plant tests of the method have confirmed its practicability for the purpose and have provided a great deal of engineering data for possible design and operation of a commercial-scale plant. It has not been possible, however, to extend the tests to the point of determining closely the power requirements, and, in turn, the capital expenditure and operating costs for a commercial-scale plant. A number of estimates of the capital investment and operating expenses of such plants have been made. These estimates vary widely, generally ranging from $2,300,000 to $5,000,000 for a plant with a processing capacity of 100,000,000 cu ft of gas per day, removing 10-15 per cent nitrogen under typical conditions of interest in this study. Similarly, the operating costs range from as low as 1.2 cents per M cu ft of gas processed to as high as 3.5 cents.

A large number of patents have been obtained on gas separation methods using liquefaction and fractionation. Most of the patents refer to the separation of oxygen from air, but some cover the general field of separation of gaseous mixtures by low-temperature processing. At least two patents are known to have been issued for nitrogen removal processes using liquefaction and fractionation. One of these patents was issued in 1921.

The second best prospect for nitrogen removal appears to be the recently developed Hypersorption process, which utilizes fractionation on a moving-bed of activated charcoal in a continuous process to effect separation of gaseous mixtures. Industrial applications of the process are few and limited in scope. Also, they have been operating for a relatively short time.

* * *

*Report on Nitrogen Removal Project NGD-6, a cooperative research project between the U. S. Bureau of Mines and the Natural Gas Department of the American Gas Association. Presented before Natural Gas Department, American Gas Association, Tulsa, Oklahoma.

†U. S. Bureau of Mines, Amarillo, Texas.

In general, the process is probably less advanced than liquefaction and fractionation and the preliminary estimates of comparative costs are less favorable for the Hypersorption process. However, there are reports of substantial improvements in the Hypersorption process and it may well prove to be equally or better suited than other methods to the problem of nitrogen removal. Proposals have been made and given some consideration with respect to pilot plant tests of this process as applied for nitrogen removal.

Other, less favorable, methods for gas separation have been reviewed. None is considered to offer particular promise, especially as compared to the two methods previously cited herein. It is of interest to note that work has been done on two methods and a patent issued on one, to remove nitrogen by processes depending upon direct chemical reactions involving nitrogen. One of the methods is of particular interest because it involves chemical combination of nitrogen with lithium and subsequent recovery of the lithium in a regenerative process. Such methods are not considered to hold forth much promise but the extremely meager information available does not permit complete appraisal.

Funds Expended

From the beginning of this investigative work to March 31, 1950, the American Gas Association had expended approximately $24,500 in connection with this cooperative project. In the same period, the Bureau of Mines had expended approximately $56,000 in direct expenses, exclusive of any charges for equipment, facilities, and so forth, for low-temperature processing, much of which was available to the Bureau at its helium plants for use in the pilot plant tests.

Future Work

The future work on this project will depend upon pending decisions of the AGA Nitrogen Removal Subcommittee. The committee has felt that interest in nitrogen removal has decreased to the point that a reappraisal of the project is desirable before proceeding with any substantial amount of additional work. Current work on the pilot plant tests was discontinued in February of this year and attention is being devoted exclusively to preparing reports for publication on the results of the pilot plant tests and other studies that have been made incident to this work. It is planned tentatively to conclude work on the problem by the end of 1950. * * *

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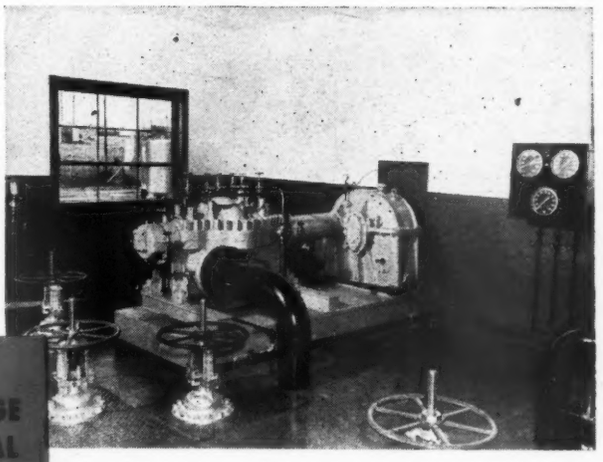
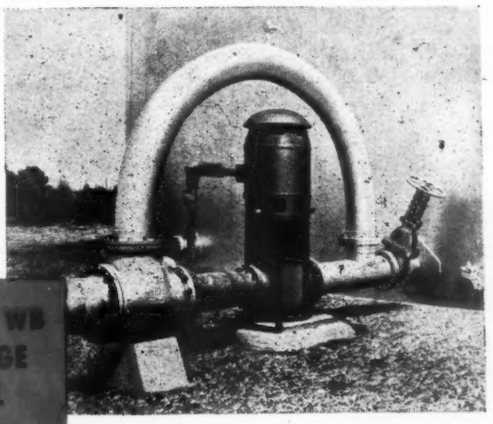


Pacific Type F Pump on Product Line

Type F MULTI-STAGE HORIZONTAL

For general pipe line service—Capacities: 5,000 to 80,000 bbls. per day; pressures to 1,200 psi. All conventional drives.



Pacific Type WY Pump in booster service

Types WY & WB MULTI-STAGE VERTICAL

For feeder lines, trunk lines, booster service.

TYPE WY—Capacities: 1,375 to 375,000 barrels per day; pressures to 500 psi.

TYPE WB—Capacities: 1,375 to 17,000 barrels per day; pressures to 2,000 psi.

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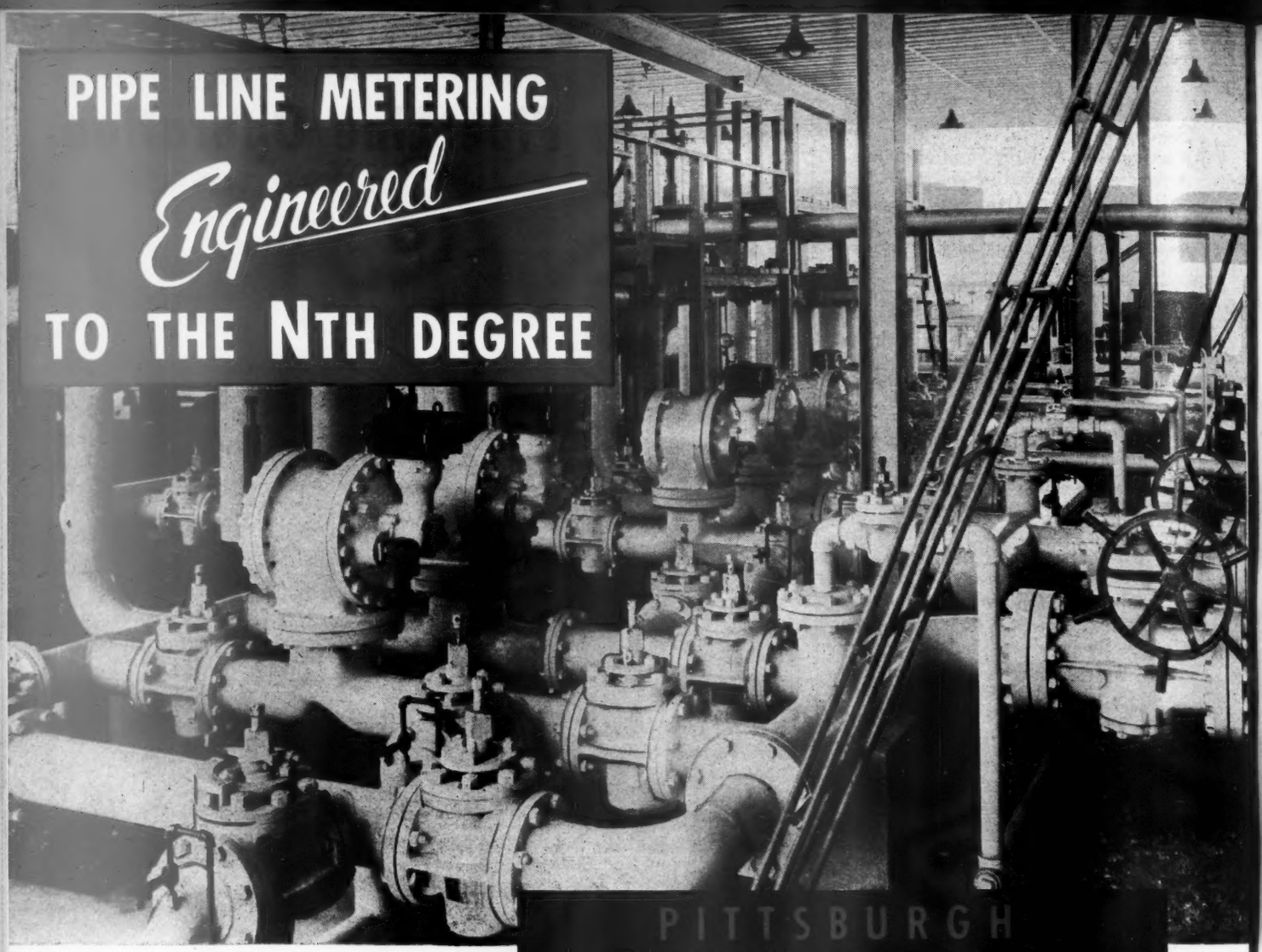
PIPE LINE METERING *Engineered* TO THE NTH DEGREE



Meter bank on Plantation line. Model 6 PL Rotocycles with straight reading registers and temperature compensators are used.

PITTSBURGH

ROTOCYCLE

METERS

COUNT OUT THE BARRELS AS THEY ROLL THROUGH THE LINE

Model 6 PL Rotocycle with large straight reading re-set register—capacity 1150 barrels per hour. Three smaller sizes available. Ticket printers and other type registers optional.

The battery of Rotocycle meters pictured is typical of hundreds of installations on major pipe lines throughout the country. Here is measurement engineering at its finest. The battery type installation assures stand-by equipment available for maintenance, proving and shut downs. The size and number of Rotocycle meters has been carefully calculated in relation to full line capacity. Manifolding is flexible. All lines are under the quick, positive control of Nordstrom valves. Want the finest pipe line meters and the all-important measurement engineered installations that go with them? Then get in touch with our nearest District Office.

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Proper Installation and Care of Anti-Friction Bearings

Two reasons why ball and roller bearings commonly fail prematurely are: Improper installation and care. When installing it is just as important to protect the bearings against dirt and grit as it is to attend properly to the mechanical details of alignment, housing, and oiling. Many installers of anti-friction bearings seem to think nothing of the extreme care with which the manufacturers cover the bearings with rust preventive, wrap them, and seal them, so that dust, grit, and moisture cannot get in.

An excellent method, when installing anti-friction bearings, is to clean thoroughly the housing in which the bearing is to be installed. Blow with compressed air, if available. Wash with gasoline. Wipe clean with new wrapping paper. New paper is preferred to rags or cloth because paper does not leave lint and is not likely to make the surfaces dirtier because the paper is *new*. An objection to rags is that they are commonly used until they themselves become seriously dirty. Care exercised in keeping dust and dirt out of the bearing is invariably paid for over and over in longer bearing life.

Of supreme importance, of course, is smoothness of bearing surface. Just as soon as the surface becomes the least bit rough it ceases to operate silently and smoothly and its coefficient of friction increases. Expose any unprotected highly polished surface to the atmosphere and it is likely to pit in a surprisingly short time. Yet we frequently see spare bearings exposed to the atmosphere, steam, and corrosive gases—bearings that may not be put into use for months or years. Wrappings are sometimes carelessly removed and the protective layer of rust preventive is rubbed off in spots. As a result, even before the bearing goes into service, it is ruined.

Lubrication is most important after the bearing is installed. Never use a lubricant that has graphite in it. Owing to the fact that it is a solid, graphite has ruined many a ball bearing. Use a lubricant that does not vaporize easily, otherwise if the bearing is not used for some time the lubricant will evaporate from the balls and surfaces not immersed in the oil, exposing the surfaces to the atmosphere, moisture, and gases, and pitting will be the inevitable result. Properly designed bearings seldom require re-oiling and for that reason as well as for the protection of the bearing it pays to use a high grade lubricant. For instance, I have in mind a case where upon installation the proper oil was used. Everything went well until one year later when the operator decided to save money by using a cheaper oil that was said to be "just as good." The temperature immediately went up 44 F and forthwith the owner changed his mind. Never use an animal or vegetable oil on anti-friction bearings. Such oils commonly break down and form acids and alkalis. Use only the purest mineral oil.

Lastly, briefly, and summing up:

(1) Use anti-friction bearings of correct size;

(2) use the correct type;

(3) install them correctly;

(4) use high grade mineral oil;

(5) take good care of the bearings, and

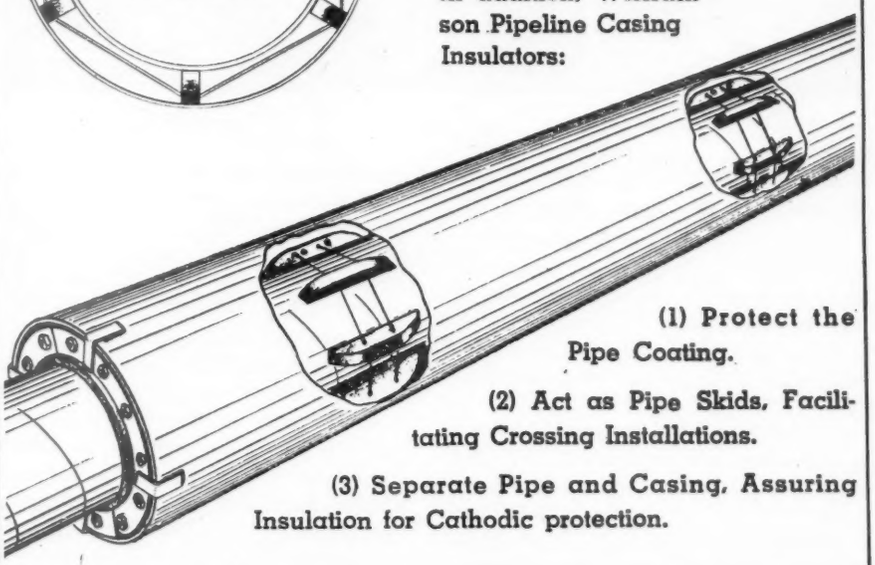
(5) take good care of bearings; and

(6) be sure that your spare bearings are generously covered with a good rust preventive, wrapped, and sealed.

W. F. S.

WILLIAMSON "CONCENTRIC SUPPORT"
PIPE LINE CASING INSULATOR*

This improved Williamson Pipeline Casing Insulator approximately centers the line pipe in the casing. This removes support of pipe from "WmSEAL" Casing Bushings, and facilitates their installation. In addition, Williamson Pipeline Casing Insulators:



(1) Protect the Pipe Coating.

(2) Act as Pipe Skids, Facilitating Crossing Installations.

(3) Separate Pipe and Casing, Assuring Insulation for Cathodic protection.

THE PIG WITH THE POKE
CLEANS PIPE LINES

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NEWS

Third Quarter Natural Gas Sales Increase

Total revenues from sales of gas by utilities for the third quarter of 1950 were $337,000,000, an increase of 13 per cent over the like quarter of 1949, the American Gas Association reports. Revenues from industrial sales represented the highest percentage gain, rising 22.5 per cent, and this increase can be partially attributed to larger industrial gas sales as a result of the gain in industrial production since the outset of the Korean conflict. Residential gas revenues were up 8.4 per cent and commercial gas revenues gained 5 per cent.

The gas utility industry was serving 23,600,000 customers at the end of September 1950, about 5 per cent more than the year before.

Total revenues from natural gas sales during the third quarter were $229,000,000, a rise of 23.2 per cent over the comparable quarter of 1949. For the 12 months ending September 30, revenues from natural gas sales were $1,281,000,000, an increase of 20.6 per cent over 1949 when natural gas revenues were $1,062,000,000.

Sales of natural gas during the third quarter totaled 741,000,000,000 cu ft, an increase of 18.7 per cent over the like quarter of 1949. For the year ending September 30, sales of natural gas amounted to 3,533,000,000,000 cu ft, a gain of 15.9 per cent over sales of 3,048,000,000,000 cu ft, in the like period a year earlier. At the end of September, about 14,500,000 customers were being served with natural gas, an increase of 15.3 per cent over the previous year. Approximately 800,000 of this increase can be attributed to the change-over from the distribution of manufactured or mixed gas to the distribution of natural gas in the cities of Baltimore, St. Louis, Milwaukee, and Louisville.

Committees Announced by Tulsa Pipe Liners Club

The members of two committees, program and membership, have recently been announced by J. D. Jones, president of The Pipe Liners Club of Tulsa.

The program committee is composed of F. C. Whiteside, chairman, G. P. Jennings and N. A. Ludewick.

On the membership committee are J. D. Jones, chairman, J. F. Nickell and Donald B. Good.

Hearing on Sale of Lateral Postponed

The Federal Power Commission hearing on the proposed sale by Virginia Gas Transmission Corporation of a lateral natural gas pipe line to Lynchburg Pipe Line Company has been continued from December 8 to March 12 in Washington, D. C. The continuance was requested by Lynchburg Pipe Line Company.

Hiram J. Carson | Joe T. Innis | W. Larry Shomaker | John M. Hanley | Myrven L. Mead

Northern Natural Men Promoted to New Posts

John Merriam, president of Northern Natural Gas Company, announces that the board of directors has elected five new company officers. The appointments include four newly created position: A first vice president, two vice presidents, and an assistant to the president. This is part of a program to further delegate authority and responsibility to key men in the company.

Hiram J. Carson was advanced to first vice president, from his position of vice president in charge of operations. In his new position he will have increased executive and policy making responsibilities.

Carson has had a long career in the gas industry. Before joining Northern in 1930 as chief engineer, he was operating head of a utility in Cedar Rapids, Iowa. He has been active for many years in natural gas associations and is past president of the Midwest Gas Association.

Joe T. Innis was promoted to vice president in charge of operations. He was formerly superintendent of operations. He will be in complete charge of the pipe line, compressor, dispatching, measurement, engineering, and construction departments.

Innis first joined Northern in 1930, as a field surveyor. This was the first year of the company's life. In that year, he was present when the first section of pipe line was laid on Northern's vast system. This occurred near Clifton, Kansas. Innis came up through the operating departments and in 1943 was made general superintendent of operations.

Larry Shomaker was elected vice president in charge of sales. His previous position was superintendent of gas sales. He also started with Northern in its first year, 1930. He is first vice president of the Midwest Gas Association.

John M. Hanley was named vice president in charge of gas supply. He will handle all negotiations for obtaining additional supplies of gas and gas leases. He will also be responsible for drilling gas wells and exploration. Hanley joined Northern in 1933 at Otis, Kansas, as a field production man. He was promoted to head of the production department in 1942. During World War II, he served on a committee for the Petroleum Administration of War.

Myrven L. Mead, company rate engineer, was elected assistant to the president. In this capacity he will have various administrative and executive duties. Mead is also a veteran employee. He joined Northern in 1931, shortly after his graduation from the University of Nebraska, where he received a degree in electrical engineering. His first job was distribution engineer, and since that time he has served in the construction, engineering, sales, and rate departments.

Northern's seven directors are: Farrar Newberry, Max Miller, John F. Merriam and Hiram J. Carson, all of Omaha; Burt R. Bay, retired president, now of Granville, Ohio; Mark Adams, attorney, Wichita, Kansas, and Guy Reed of Chicago.

McKenzie New Service Nebraska Division Manager

O. O. McKenzie formerly of Galesburg, Illinois, has been appointed Nebraska division manager of the Service Pipe Line Company, succeeding W. S. Partner, Scottsbluff, Nebraska, who retired December 28.

A former district superintendent in Illinois, McKenzie was named to succeed Partner, by J. R. Polston, general manager of the 11,450-mile pipe line company, at a banquet honoring Partner. J. L. Burke, president, and the company's board of directors, in addition to 80 Nebraska supervisors, attended the banquet.

Partner, a pipeliner since 1902 and an employee of Service Pipe Line Company for 34 years, received numerous gifts and commendations from company officials. He has been the Nebraska division manager with headquarters at Scottsbluff since 1945.

McKenzie joined the firm in 1925 as a telegraph operator. He will become one of the company's eight division managers. The Nebraska division runs from the Wyoming line to Freeman, Missouri, transporting about 50,000 bbl of crude oil daily.

Pacific Pipe Line and Engineers Changes Name

Pacific Pipe Line and Engineers, Ltd., San Francisco, California, has changed its name to Engineers Limited Pipe Line Company. There has been no change in personnel, management, or ownership, it is announced.

In addition to the main office in San Francisco there are branches at El Cerrito, Bakersfield, Fresno, and Avenal, California, and Denver, Colorado.

J. L. Burke Heads Pipe Line Committee

J. L. Burke, Tulsa, president of Service Pipe Line Company, was elected chairman for 1951 of the Committee for Pipe Line Companies during the committee's annual meeting, December 12, in Chicago. He succeeds William C. Kinsolving, Philadelphia, president of Sun Pipe Line Company.

Ralph B. McLaughlin, Houston, Texas, president of the Texas Pipe Line Company, was elected vice chairman. He succeeds Burke.

Reelected were J. L. Seger, Tulsa, executive vice president of Interstate Oil Pipe Line Company, treasurer; Fayette B. Dow, Washington, D. C., general counsel, and Gordon C. Locke, Washington, D. C., executive secretary and associate general counsel.

The Committee for Pipe Line Companies is composed largely of representatives of common carrier crude oil and products pipe lines that report to the Interstate Commerce Commission.

It was originally organized in 1945 for the purpose of gathering information and preparing a reply in response to the transportation inquiry conducted by the Committee on Interstate and Foreign Commerce of the House of Representatives under the authority of House Resolution 318, 79th Congress.

Utah Pipe Line Seeks Authorization

Utah Pipe Line Company, of Dallas, Texas, has asked the Federal Power Commission for authority to construct and operate a 392-mile natural gas transmission line extending from a point near Aztec, New Mexico, to the Salt Lake City, Utah, area. Estimated cost of the project is approximately $22,000,000.

The company, recently formed for the purpose of constructing the proposed pipe line, plans to serve natural gas primarily to industrial consumers in the Salt Lake City area, and also proposes to serve towns and communities along the route of its system in Colorado and Utah. The latter communities include Cortez, Colorado, and Moab, Green River, Wellington, and Price, Utah.

The application says that the main line facilities would consist of approximately 374 miles of 22-in. line and 18 miles of 16-in. line, with lateral lines of smaller diameter pipe as may be necessary to serve certain proposed customers. The system would have a maximum capacity of 96,000,000 cu ft a day. The company estimates initial daily demand as ranging from 60,000,000 to 95,000,000 cu ft.

Heckman Heads FPC Gas Certificates Division

The Federal Power Commission has appointed Loring E. Heckman chief of its division of gas certificates to succeeed James V. O'Connor, who resigned to enter private practice.

Heckman joined the FPC staff in September, 1945, and has served as head of the gas resources section of the division of gas certificates since January of this year. Prior to his service with the FPC, Heckman was division chief in the natural gas section of the Petroleum Administration for War, and before entering federal service in 1942 was associated with the United Fuel Gas Company, of Charleston, West Virginia. He is a graduate of Rennselaer Polytechnic Institue.

O'Connor has been with the Federal Power Commission since September, 1934, and has been chief of the division of gas certificates since July, 1946.

Pipeliners' Short Course Again Planned for Tulsa

Another short course on practical control of pipe line corrosion has been scheduled for February 21-23 by the Tulsa Section of the National Association of Corrosion Engineers who conducted the first school of this type last February.

Need for such training was evidenced last year by attendance of 178 foremen, superintendents, engineers and inspectors from all parts of the country. Subsequently, other N A C E groups held similar schools at Shreveport, Louisiana, and Cleveland, Ohio, to meet demands of the fast-growing pipe line industry, and N A C E leaders predict that, like the Tulsa short course, they will be repeated annually.

General chairman for the Tulsa school is J. N. Hunter, Jr., Service Pipe Line Company, assisted by Hugh A. Brady, Gulf Refining Company (field work), Yale W. Titterington, Dowell, Incorporated (demonstration-discussions), Maynard H. Jackson, Middle West Coating and Supply (hotel and transportation), and T. D. Williamson, Jr., T. D. Williamson, Incorporated (publicity).

According to Hunter, the course will be divided equally between field work at pipe line locations near Tulsa and discussion-demonstration sessions at the Mayo Hotel with each phase being conducted on a practical level by a pipeliner with broad experience in the mitigation of corrosion.

With two exceptions, the program will follow that of last year directed by R. L. Bullock. The course will be covered in three days instead of four; operation of two or more classes simultaneously will limit each group to a workable number, insuring wider participation in discussion sessions.

Hunter stated that the program is designed to serve a two-fold purpose: (1) To acquaint field men with the "why" and "how" of corrosion control so that they may participate more effectively in this phase of their company's operations; (2) to acquaint corrosion engineers with various techniques for disseminating information on corrosion control to company personnel.

Major items to be covered during the course include corrosion and its control — a non-technical discussion; coating materials and application; rectifiers; expendable anodes; corrosion surveys; use, care and handling of insulating flanges and nipples.

Inquiries for additional information and registration forms for the short course should be addressed to J. N. Hunter, Jr., Service Pipe Line Company, Box 1979, Tulsa 2, Okla.

Gas measurement course committee members. First row seated: T. S. Whitis, James L. Griffin, Ben F. Worley, W. H. Carson, R. O. Cox. Second row: Roy S. Peace, Jr., Walter A. Brewster, R. R. Suttle, W. H. Woods, R. M. Scofield, K. R. Tibbets, E. L. Stark. Third row: T. J. Kirkpatrick, Dean Bruce, George E. Greiner, M. D. Gilbert, J. H. Satterwhite, George H. Smith, Charles A. Breitung. These 19 members of the general and executive committees met at Norman, Oklahoma, to plan the gas measurement short course to be held at the University of Oklahoma April 10 to 12, 1951.

Complete Plans for Gas Measurement Course

Plans and program for the Southwestern Gas Measurement Short Course to be held at the University of Oklahoma, Norman, Oklahoma, on April 10, 11, and 12, 1951, were completed at the fall meeting attended by 19 members of the general and executive committees.

The chairman of the general committee, Ben F. Worley, United Gas Corporation, presided at the meeting. The executive committee was represented by Chairman W. H. Carson, Dean, College of Engineering, The University of Oklahoma; R. M. Scofield, Lone Star Gas Company, and W. H. Woods, Gulf Oil Corporation.

All sessions will again be held at the Drill Hall on the North Campus where ample facilities and space will be provided to accommodate the classroom sessions and the 30-odd firms who will exhibit equipment used in the measurement and regulation of natural gas.

The committee has planned a program that covers all phases of gas measurement work including gas accounting, metering, pressure regulation, and instrumentation. The instructors who have been invited to conduct the classroom sessions and give individual instructions are outstanding authorities on the application, installation, servicing, and maintenance of equipment used in the measurement and regulation of natural gas. The program will be under the direction of James L. Griffin, Northern Natural Gas Company, Omaha, Nebraska.

In order that the exhibitors of educational equipment will be represented, the general committee has approved recommendations of the executive committee for the formation of an exhibitors advisory committee consisting of five members to be elected by representatives of the firms who exhibit educational equipment at the short course.

New members elected to the general committee were Gordon B. Gudger, Gulf Refining Company, Houston, Texas, representing the South Texas Area and replacing W. H. Woods, Gulf Oil Corporation, Houston, who served as general chairman for the 1950 short course and is now a member of the executive committee; C. A. Breitung, gas supervisor, Railroad Commission of Texas, and Elmer Capshaw, gas engineer, Oklahoma Corporation Commission, representing two of the commissions who are sponsors of the short course.

Latex Construction Company Liquidated

Latex Construction Company, Houston, Texas, has been liquidated and will no longer engage in pipe line construction, according to a recent announcement. Laurence H. Favrot and R. P. Gregory have formed a partnership under the name Houston Contracting Company for carrying on general pipe line and allied construction work. The new firm has its offices at 2707 Ferndale Place, Houston.

George A. Peterkin is associated with the company. J. W. Sharman has retired from this line of business.

Bad Usage of Wrenches

Several times we have seen the "kink" in print that shows how to make a wrench longer by "slipping a gas pipe over." It is a very simple procedure and it may look and sound good to some mechanics, but we don't believe in making a wrench longer in order to put nuts on tighter.

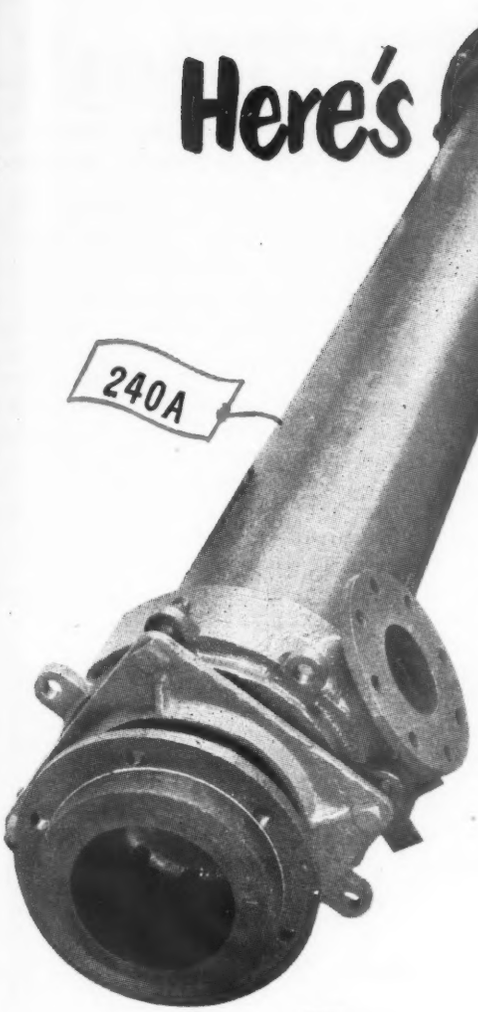
As you doubtless have observed, wrenches for small nuts are invariably short; for medium nuts, medium in length, and for large nuts, they are long. The manufacturers, therefore, seem to have some system in making wrench lengths, and they have. The pitch of the thread is considered, the cross-sectional area of the bolt at the bottom of the threads is considered, and the strength of the average man who does the tightening is also considered.

To make a wrench "twice as long," therefore, increases the tension on the bolts to twice the amount, the force of pull on the wrench being the same. By increasing wrench lengths, the writer frequently has actually "stretched" bolts until they broke in two, or has stopped turning as soon as it was felt that the bolt began to stretch. This is poor practice and it should not be done. Do not increase a wrench's length. The elastic limit of a bolt should never be reached.

If you feel like making a wrench longer for "unscrewing" a nut, all right, but don't make it longer for tightening; you may thereby ruin some valuable equipment and may even cause a serious accident.

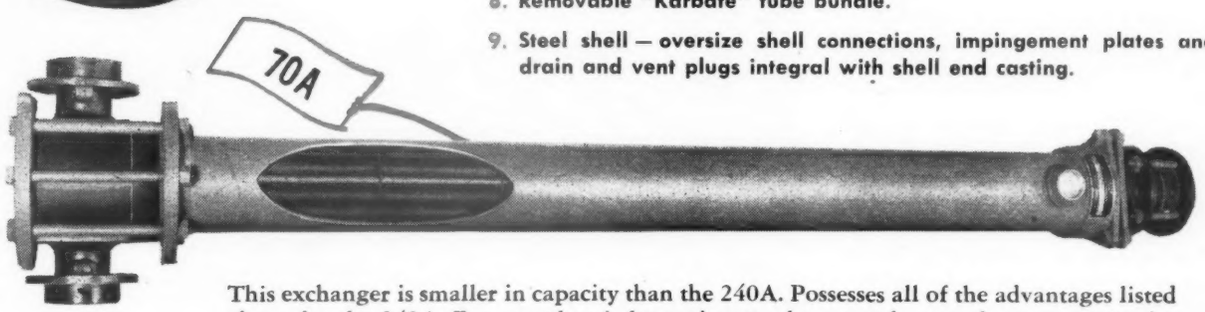
—*By W. F. Schaphorst*

Here's the dope on 2 "KARBATE" IMPERVIOUS GRAPHITE HEAT EXCHANGERS



The new No. 240A is a shell-and-tube heat-exchanger made of "Karbate" brand impervious graphite . . . similar in construction to the familiar No. 70A . . . but with almost three times as much total effective external heat transfer surface. Advantages are:

1. **70.6 sq. ft. of external heat transfer surface.**
2. **Single, double or four-pass routing of tube-side fluid is effected by a simple change of fixed and floating end-cover assemblies.**
3. **Wide variety of corrosive fluids handled with negligible maintenance.**
4. **Thermal shock resistance.**
5. **Very high heat transfer rates.**
6. **Stainless steel baffles.**
7. **Easy tube replacement in the field.**
8. **Removable "Karbate" tube bundle.**
9. **Steel shell — oversize shell connections, impingement plates and drain and vent plugs integral with shell end casting.**



This exchanger is smaller in capacity than the 240A. Possesses all of the advantages listed above for the 240A. For complete information on these two heat exchangers, write for catalog sections S-6715 and S-6690. Address National Carbon Division, Dept. PE.

A LITTLE PICK-ME-UP OF H_2SO_4 MAY HELP THAT INDIGESTION I'VE BEEN GETTING FROM 'KARBATE' IMPERVIOUS GRAPHITE
CRUSTY RUSTY
SULPHURIC ACID

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With the revolutionary new "Eveready" No. 1050 Flashlight Battery you get these big exclusive features:

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Why? Because of the *exclusive* "inside-out" construction of the "Eveready" No. 1050 battery. Instead of being the container for the cell, the zinc electrode is on the inside to make the battery last longer, while the new outside carbon jacket makes the battery leakproof. Order a supply of No. 1050's *today*.

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NEWS

Iraq Petroleum Pipe Line Under Construction

The first shipment of pipe for the 30-in. pipe line being constructed by the Iraq Petroleum Company, Ltd., which will treble current deliveries of Kirkuk crude oil to the Mediterranean, has arrived at Tripoli.

The line, which will have a capacity of 13,000,000 tons a year, will connect the Kirkuk oil field in Northern Iraq with the Mediterranean seaboard at Banias. It will be 560 miles long and will require 145,000 tons of 30/32-in. pipe, and 23,000 tons of 26-in. pipe. Arrangements have been made with Furness Withy and Company for the charter of 42 vessels for shipping the pipe from the United States to the Mediterranean port of Tripoli, (Lebanon) and to Basrah in the Persian Gulf. To convey it to site from these ports will involve 25,000,000 ton-miles of rail transport, and another 25,000,000 ton-miles of motor transport across the Iraq and Syrian desert.

Laying of the pipe has begun and the project is due for completion in 1952. The pipe has been ordered from the Consolidated Western Steel Corporation of Los Angeles, and the National Tube Company of Lorain, Ohio. The pump station and auxiliary equipment has been ordered in the United Kingdom.

Preparations for expanding the production of the Kirkuk field from the 1950 level of 6,000,000 tons are well in hand, and when the new line is complete in 1953, more than 18,000,000 tons per annum of Iraq crude oil will flow to the Mediterranean, for the markets of Western Europe.

Gas Transmission Safety Men Organize

At a recent meeting in Garden City, Kansas, a new organization was formed having as its purpose the holding of periodic safety conferences by safety directors and engineers of the natural gas transmission group of the gas industry. Leo F. Dippel, safety director of the Northern Natural Gas Company, was elected chairman.

The overall aim of the organization is the reduction of accident frequency and severity through the confidential exchange of information and ideas between safety representatives of the member companies.

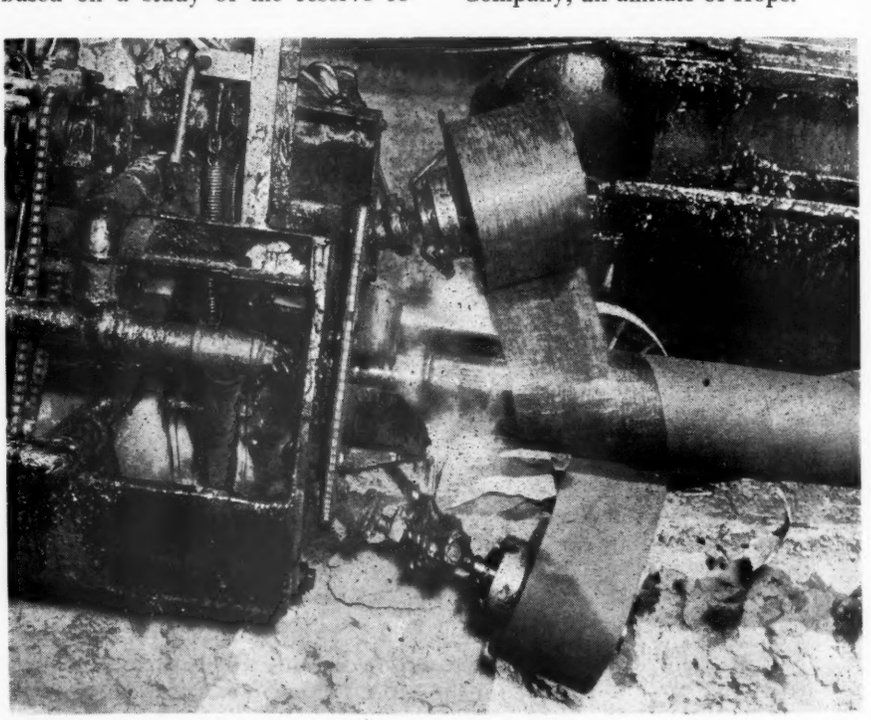
Bob Hill of Cities Service Gas Company is in charge of arrangements for the next meeting, which probably will be held in February or March.

Transfer of Natural Gas Facilities Authorized

The Federal Power Commission has issued an order authorizing the acquisition, abandonment, and transfer of natural gas facilities in West Virginia by Monongahela Power Company, of Fairmont, West Virginia, State Line Gas Company, of Point Marion, Pennsylvania, and Hope Natural Gas Company, of Clarksburg, West Virginia.

Hope plans to acquire Monongahela's entire natural gas production, storage, transmission, distribution, and sales system in Marion, Monongalia, Harrison, and Wetzel counties, West Virginia. The commission said that the base purchase price to be paid by Hope, $2,369,351, is in excess of net original cost, and directed that company to submit for consideration by the FPC proposed journal entries based on a study of the reserve requirements properly applicable to the properties to be acquired and to submit proposed accounting entries for disposition of the excess over original cost of the purchase price.

Monongahela, a subsidiary of The West Penn Electric Company, renders electric and natural gas service in West Virginia, supplying gas to its wholly-owned subsidiary, State Line, at one point on its system, and receiving gas from State Line at another point. After acquiring Monongahela's facilities, Hope will supply the natural-gas requirements of State Line over and above quantities available to it from other sources. This sale and delivery will be made until State Line's natural gas system in Pennsylvania has been sold to Peoples Natural Gas Company, an affiliate of Hope.



Applying Fiberglas pipe wrap before line is buried.

Coromat Used on New Susquehanna Pipe Line

The new parallel-reinforced Coromat, Fiberglas underground pipe wrap, was applied to the pipe line that was constructed by the Sun Oil Company from Toledo to Sarnia, Ontario, Canada. Vernon C. Goff, division superintendent of the Susquehanna Pipe Line Company, Sun Oil subsidiary, said there were few breakages of the Coromat on the 126-mile line. The pipe line, which has an outside diameter of 8⅝ in., will carry butane and propane gas, gasoline, and furnace oil.

In the first step, the pipe was cleaned with a pipe cleaning machine. Then one coat of prime paint was applied and allowed to dry and after that the pipe was flooded with an enamel paint. Then the wrapping was done, with the Fiberglas Coromat applied and covered with a felt paper.

The Gentry Construction Company of Jackson, Michigan, was the contracting firm on the Toledo-Sarnia pipe line. Coromat is fabricated from minute glass fibers, chemically-resistant, bonded together with a tough, elastic resin to form a thin, porous, flexible mat. The function of Fiberglas in the reinforcement of pipe covering enamels is similar to the use of steel rods in the strengthening of poured concrete.

PIPELINE PERSONALS

Frank Willenburg has assumed the duties of division manager for the Central and East Texas division of Service Pipe Line Company, succeeding **J. J. Hill,** retired. He has his headquarters in Fort Worth. Willenburg has been with the company since January 1, 1922, and recently has been assistant division manager to Hill. Prior to that he was assistant division manager in charge of southern Oklahoma districts, making his headquarters in Shawnee. Hill has been in the employ of the company since July 10, 1919.

Ellis Orr has been promoted to superintendent of the Carlson, Oklahoma, district, succeeding **James E. Laughorn,** who has been retired. He is making his headquarters at Cushing. Orr entered service with the company November 6, 1933, beginning as a laborer in the Seminole district. Laughorn has been with the company since July 25, 1920.

George L. Miller, 31 years with the company, has been promoted from area master mechanic at Fort Worth to superintendent of the west Illinois district. **O. O. McKenzie,** whom he succeeds, has been transferred to Scottsbluff. Miller's headquarters are at Galesburg, Illinois.

Gus L. Maciula, area engineer in the West Texas division, has been assigned as senior engineer in the engineering department at Tulsa.

John C. Papp recently joined the Transcontinental Gas Pipe Line Corporation staff as a reservoir engineer. Papp, a graduate of the University of Pittsburgh, formerly was associated with J. R. Butler and Company and the Carter Oil Company. He will work from the company's headquarters in Houston, Texas.

Evan Griffiths has been named assistant superintendent of its Beatrice, Nebraska, compressor station by Northern Natural Gas Company. **Roy Spratt** has been made assistant superintendent of the Palmyra, Nebraska, station. Both men have been acting assistant superintendents of their respective stations during construction.

Charles L. Lockhart, manager of Shell Oil Company's Sewaren, New Jersey marine terminal, died recently in Detroit. He was 57. Lockhart was stricken while visiting his son, a field representative for the Lincoln-Mercury Division of Ford Motor Car Company.

Lockhart joined Shell in 1928 as an automotive inspector in St. Louis. In 1931 he was made automotive superintendent of Shell's Chicago marketing division. During the following nine years he filled various positions, including those of division operations manager, acting division manager in Kansas City, and field assistant in the operating department in Shell's head office, New York. In December, 1940, he was promoted to the position of operations manager of the Cleveland marketing division, where he remained until September, 1946, when he was advanced to the post he held at the time of his death. During the war he served on the policy board of the ODT's National Tank Truck Advisory Committee.

George C. Grow, Jr., formerly geologist with the Peoples Natural Gas Company, has joined the Transcontinental Gas Pipe Line Corporation as manager of the underground gas storage department. He will have his headquarters at 1060 Broad Street, Newark, New Jersey.

Grow is a graduate from Lehigh University and has held various offices with the American Association of Petroleum Geologists and the Geological Society of America.

H. R. Swift, superintendent of right-of-way for the Service Pipe Line Company, spoke on "Public Attitude Toward Pipe Lines" before the December meeting of The Pipe Liners Club of Tulsa.

F. B. Plank of Bartlesville, Oklahoma, has been elected a director, vice president, and secretary of Cities Service Oil Company (Delaware) and Cities Service Pipe Line Company effective January 1, according to an announcement by **A. W. Ambrose,** president. He succeeds **C. E. Murray,** who retired on December 31, after nearly half a century of employment with the Cities Service organization.

Plank is a graduate of Purdue University. After graduation, he was employed as industrial engineer before joining the Cities Service organization in 1918 at Bartlesville. At the end of 1920, he was placed in charge of federal income taxes and, two years later, became manager of both the tax and budget departments.

From 1928 to date, Plank has devoted most of his time to tax matters and has served as tax adviser to Cities Service Gas Company and Arkansas Natural Gas Corporation.

Robert E. Kepke and **H. T. O'Neill** have been appointed directors of the newly formed Platte Pipe Line Company. Kepke is vice president of supply and transportation for British American Oil Company and O'Neill is the company's vice president of finance.

B-A, together with four major U. S. petroleum companies, is participating in building the $60,000,000 Platte crude oil pipe line from Wyoming to Wood River, Illinois. Scheduled for completion in late 1951, the new line will enable B-A to increase production in its wholly owned Wyoming Steamboat Butte field, which has reserves in excess of 50,000,000 bbl. Aerial maps for 710 miles of the 1080-mile line already have been completed.

Kepke is vice president of the British American Oil Producing Company and the Toronto Pipe Line Company, B-A subsidiaries operating in the United States. Both Kepke and O'Neill are directors of the Portland-Montreal Pipe Line Company in which B-A has a 20 per cent interest.

Commissioner Thomas C. Buchanan of Pennsylvania has been re-elected vice chairman of the Federal Power Commission to serve during the calendar year 1951. Buchanan first was elected vice chairman in May, 1950. He has been a member of the FPC since July 14, 1948.

S. S. Smith, New York, manager of products pipe lines for Shell Oil Company, Inc., has been awarded an honorary membership in The Pipe Liners Club of Tulsa. Others recently accepted as members are: **Lowell E. Anderson,** hydraulic engineer, Service Pipe Line Company, Tulsa; **V. J. Sittel,** senior engineer, Service Pipe Line Company, Tulsa, and **George Downs,** manager, Design Division, Engineering Department, Phillips Petroleum Company, Bartlesville, Oklahoma.

L. T. Cain, Iraan, Texas, has been promoted from district gauger to district chief gauger by Shell Pipe Line Corporation. Among other promotions are:

J. E. Fairweather, station chief engineer, Monahans, Texas, to district chief gauger, Goldsmith.

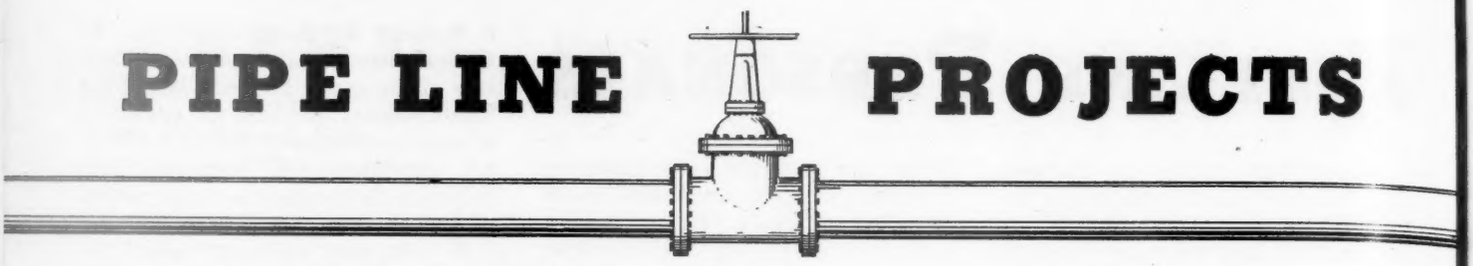
L. L. Gentry, district gauger to district chief gauger, Hobbs-Monument.

I. C. Murphy, district foreman to district superintendent, Cushing, Oklahoma.

N. F. Schreiner, acting area engineer, to area engineer, Cushing.

H. P. Shockley, district gauger to district chief gauger, Avant.

PIPE LINE PROJECTS



Another Texas-California Oil Line Proposed

A second application has been made to the Petroleum Administration for Defense in Washington for construction of a crude oil line from the West Texas Permian Basin area to California. Applicants are Marc D. Leh and David E. Brown, owners of the Progress Company, Los Angeles. A group of Texas and New Mexico men previously had made application under the name of the West Coast Pipe Line Company.

The recent proposal contemplates a 24-in. line from the Permian Basin to Long Beach, California, a total of 1050 miles. It would be built and operated under the name Progress Pacific Pipeline Company and would have a daily capacity of 300,000 bbl of crude oil. In addition, a 10-in. products pipe line having a daily capacity of 65,000 bbl would be constructed parallel to the crude oil line.

Leh, in making the announcement, said he and Brown conceived the idea of an oil line between California and Texas in 1941. "We have completed our plans," he said, "and private financing is arranged for. This war emergency, however, has caused us to step up our schedule."

He further stated that they were in position to begin work on the system within 60 days after the application is approved and complete it in 12 months. The application to PAD is for a certificate to enable them to acquire the necessary steel.

The firm of Ford, Bacon and Davis would construct the line, Leh said.

Kansas-Nebraska Natural Would Increase Capacity

Kansas-Nebraska Natural Gas Company, Inc., of Phillipsburg, Kansas, has applied to the Federal Power Commission for authorization to increase the capacity of its natural gas transmission system from approximately 146,000,000 cu ft a day to about 164,200,000 cu ft daily. Estimated cost of the project is $5,201,331.

The proposed construction program includes three new compressor stations at Holcomb and Albion, Kansas, and Grand Island, Nebraska, totaling 3570 hp and an additional 2000 hp at the company's Palco compressor station; additional cooling equipment at its Scott City, Kansas, compressor station; and a 44,000,000 cu ft capacity dehydration plant at the proposed Holcomb compressor station.

Pipe line construction plans include 16 miles of 12¾-in. loop and 73½ miles of 12¾-in. line replacing a like amount of existing 6⅝ and 8⅝-in. line; approximately 5 miles of 10¾-in. and 54 miles of 8⅝-in. line; about 109 miles of 6⅝-in. and 53½ miles of 4½-in. line; and approximately 101½ miles of 3½-in. and 102½ miles of 2⅜-in. lateral pipe line, together with town border stations for delivery of natural gas for service to 37 communities in Nebraska.

Texas Illinois Given Authority for Expansion

The Federal Power Commission has authorized Texas Illinois Natural Gas Pipeline Company, of Chicago, Illinois, to construct facilities that will increase the authorized daily capacity of its natural gas transmission system from 312,625,000 cu ft to a new total of 383,350,000 cu ft.

The FPC last June authorized the company to build at a cost of approximately $117,000,000 a pipe line project extending from Texas to Illinois and having an overall length of 1331.5 miles. The system, now under construction, will carry natural gas to Illinois and Indiana.

To accomplish the new increase in capacity of the line, Texas Illinois was authorized to make certain changes in the units powering its compressor station and to build approximately 72 miles of new line in Texas in order to deliver the additional gas to the main pipe line system. Estimated cost of the program is $11,216,800.

The FPC order authorizes Texas Illinois to sell the additional gas to some of its presently authorized customers, with 7,705,000 cu ft a day to be reserved pending further order of the commission upon appropriate application. Texas Illinois has indicated that it will apply for authority to serve the 7,705,000 cu ft to distributors of gas along the route of its line.

Westcoast System Would Cost $25,690,000

The Westcoast Transmission Company, of Wilmington, Delaware, which has applied to the Federal Power Commission for authority to construct approximately 615 miles of pipe line in the Pacific Northwest to supply natural gas to markets in Oregon and Washington, estimates that the project will cost $25,690,000. It would have a designed capacity of 221,000,000 cu ft of natural gas a day in the fifth year of operation. The company proposes to obtain its supply of gas from its Canadian associate, Westcoast Transmission Company, Ltd.

The latter company is planning to build a pipeline system to transport gas from the northern areas of the provinces of Alberta and British Columbia, Canada, to a point on the International Boundary near Sumas, Washington, where it would connect with the proposed system of its United States associate. The Canadian company also plans to build a spur from a point on its main line near Princeton, British Columbia, to another point of connection with the U. S. company's system on the International Boundary west of Osoyoos, British Columbia.

Westcoast, Inc., would construct two main lines—one extending south from the Sumas area to Portland, Oregon, with short branches to Bellingham, Mt. Vernon, Everett, Bellevue, Seattle, Tacoma-Olympia, Centralia-Chehalis, and Kelso-Longview, all in Washington, and St. Helens, Oregon. The other main line, extending south from the Osoyoos area, would serve Spokane and the Atomic Energy Plant at Hanford, both in Washington.

The main line to the west coast communities would be about 277 miles long, and the line in eastern Washington would have an estimated length of 266 miles. In addition, the company would build about 72 miles of lateral lines, and some 13 measuring and regulating stations.

These facilities would have a capacity of 104,000,000 cu ft a day, and by the ultimate addition of 4000 hp in compressor capacity the designed capacity could be increased to 221,000,000 cu ft a day.

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Nevada Natural Gas Would Lay Line

Nevada Natural Gas Pipe Line Company, of Las Vegas, Nevada, has asked the Federal Power Commission to authorize the construction and operation of a 114-mile pipe line for the transportation of natural gas for resale to distributing companies in Needles, California, and Boulder City and Las Vegas, Nevada.

The pipe line, estimated to cost $2,331,350, would extend from a point on the east bank of the Colorado River, east of the Arizona-California boundary near Topock, Arizona, and extend northerly to Las Vegas. In addition to the main line, which would be of 10¾-in. diam pipe, the company proposes to build approximately 7 miles of 4-in. and 2½-in. branch lines.

The main line would have an initial capacity of 17,000,000 cu ft of natural gas a day, the application says. Nevada Natural would purchase natural gas from El Paso Natural Gas Company, and estimates the present potential requirements at 2,237,670,000 cu ft a year. In addition to supplying natural gas for resale, Nevada Natural also proposes to sell gas to industrial users in the three cities.

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FPC Grants Piedmont Natural Part of Request

Federal Power Commission Presiding Examiner Edward B. Marsh has filed an initial decision, subject to review by the commission, which would authorize Piedmont Natural Gas Company, Inc., of Spartanburg, South Carolina, to serve natural gas markets in North and South Carolina by constructing a series of lateral pipe lines extending from connections with the system of Transcontinental Gas Pipe Line Corporation, of Houston, Texas.

The examiner's decision also would authorize Transcontinental to increase the capacity of its Texas-to-New York City pipe line by 50,000,000 cu ft a day, up to 22,000,000 cu ft of which would be delivered to Piedmont.

Applications of two other companies, which were competing with Piedmont for the Carolina markets, were denied insofar as they relate to serving the markets Piedmont was authorized to supply. However, the proceedings involving these two companies—Carolina Natural Gas Corporation, of Charlotte, North Carolina, and Public Service Company of North Carolina, Inc., of Gastonia, North Carolina—were ordered reopened to afford those companies an opportunity to file amendments to their applications eliminating the communities that Piedmont was authorized to serve.

Piedmont's project includes six lateral lines, aggregating 73.7 miles. Transcontinental's proposed expansion program as approved by the Examiner includes an aggregate increase in compressor station capacity of 4800 hp in the first year and 40,875 hp in the second year of operation, thus increasing capacity of the system by 50,000,000 cu ft a day.

Southern Natural Work Authorized by FPC

The Federal Power Commission has authorized Southern Natural Gas Company, of Birmingham, Alabama, to construct line taps and metering facilities for the delivery and sale of natural gas to two natural gas districts in Mississippi—the North Central District and the Carthage District—and to two towns in Alabama—Aliceville and Carrollton.

The Commission denied, however, Southern Natural's proposals to serve a third Mississippi natural gas district, the Deer Creek District, and the towns of Ethel, McCool, and Weir, all in Mississippi. This denial was without prejudice to Southern Natural's filing of a new application.

The North Central district will construct about 98.5 miles of pipe line from Southern Natural's system in Mississippi to serve Ackerman, Mathiston, Eupora, Walthall, Maben, Mantee, Houston, Vardaman, Derma, Calhoun City, Pittsboro, and Bruce, all in Mississippi. In addition, the district will construct the distribution facilities in these communities. Upon completion of the construction, estimated to cost $1,950,000, the district plans to lease for a 25-year period all of the facilities to Mississippi Gas Company, a wholly-owned subsidiary of Southern Natural.

The Carthage district will build approximately 16.5 miles of line extending from Southern Natural's system in Mississippi to the town of Carthage, Mississippi, together with a distribution system within that community at a total over-all cost of $290,350. The Carthage district plans to lease all of these facilities to Mississippi Power and Light Company, who will operate the entire system.

The towns of Aliceville and Carrollton, Alabama, will build necessary transmission and distribution facilities at an estimated total cost of $536,000. The two towns plan to operate the transmission and distribution systems themselves.

Estimated peak day requirements of the two natural gas districts and the two Alabama communities in the fifth year of operation total 4,332,000 cu ft. Southern Natural, which will spend $67,000 to construct necessary facilities for the new service, said it has capacity on the western end of its system to supply these areas.

Propose Line to Serve Clay County, Missouri

The Central West Utility Company, of Kansas City, Missouri, has filed an application with the Federal Power Commission in connection with a proposal to construct approximately 30 miles of pipe line in the Kansas City area in order to provide additional natural gas service in the Clay County, Missouri, area.

The application asks the FPC (1) to direct Cities Service Gas Company, of Oklahoma City, Oklahoma, to connect its facilities with Central's proposed new line and to sell natural gas to Central; and (2) to authorize Central to construct the 30-mile connecting line, or, in the alternative, to dismiss the application for want of jurisdiction.

Central's proposed connecting line, to be of 12-in. pipe, would extend from its distribution system in Clay County to the Cities Service facilities near the southeast boundary of Kansas City. The line, estimated to cost $1,000,000, would have a capacity of 30,000,000 cu ft a day.

Gas Line Approved for Southeastern Michigan

The Federal Power Commission has authorized Southeastern Michigan Gas Company, of Port Huron, Michigan, to construct natural gas pipe line facilities to serve the southeastern Michigan area, and directed Panhandle Eastern Pipe Line Company, of Kansas City, Missouri, to supply 5,000,000 cu ft of gas per day to the Michigan company, subject to 100 per cent curtailment during the coming winter.

Southeastern's project, estimated to cost $1,402,632, will consist of approximately 55 miles of 12¾-in. pipe extending from a point of connection with Panhandle's facilities in the Clawson, Michigan, area, to Marysville, Michigan, where the line will connect with existing distribution facilities to be acquired from Detroit Edison Company. The latter company now serves the area with manufactured gas.

The Southeastern system, which will have a maximum daily delivery capacity of 18,000,000 cu ft a day, will serve Port Huron, Marysville, St. Clair, and contiguous areas in St. Clair and Macomb counties. If Southeastern acquires the Detroit Edison properties, as proposed, it will maintain the manufactured gas production plant at Marysville. During periods of curtailments the plant would be operated to produce enriched manufactured gas of high Btu content, which would be substituted for natural gas.

Southeastern estimates that the 55-mile line can be completed in two months, however, the company plans to interconnect the line with the Detroit Edison system at New Haven, Michigan, a point about midway between Clawson and Marysville, and to begin conversion of a part of the Detroit Edison system to the utilization of natural gas prior to the completion of the entire line. Southeastern estimates that the entire system will have been converted during January 1951.

Texas Company to Lay Products Line

The Texas Pipe Line Company has awarded a contract to O. R. Burden Construction Company, Tulsa, Oklahoma, to construct a products pipe line between Lawrenceville, Illinois, and Mt. Vernon, Indiana, it was announced by R. B. McLaughlin, president of the pipe line company.

Approximately 56.5 miles in length, the pipe line will be 10¾ in. diam and will run parallel to the company's 6-in. products line between Lawrenceville and Mt. Vernon.

Work is due to begin in January.

Acquisition of Texoma Natural Is Sought

Natural Gas Pipeline Company of America and Texoma Natural Gas Company, both of Chicago, Illinois, have filed a joint application with the Federal Power Commission in connection with Natural's proposed acquisition and operation of all of Texoma's natural gas pipe line facilities subject to FPC jurisdiction.

Texoma now supplies Natural, its only customer, with approximately 60 per cent of its natural gas requirements, or a total of about 340,000,000 cu ft a day. The two companies are subsidiaries of The Peoples Gas Light and Coke Company, also of Chicago.

Texoma's principal transmission facilities which Natural proposes to acquire include two compressor stations, one in Hutchinson County, Texas, and the other in Moore County, Texas; a 74-mile, 24-in. pipe line from the Hutchinson County station to the inlet of Natural's system near Gray, Oklahoma; and a 70-mile, 26-in. line extending from the Moore County station to the Gray inlet. Natural will issue to the Peoples Gas Light and Coke 5000 shares of its stock in exchange for 10,000 shares of Texoma held by Peoples Gas.

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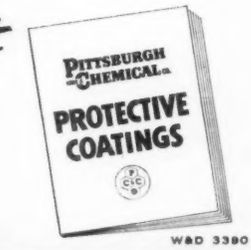

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PICTORIAL

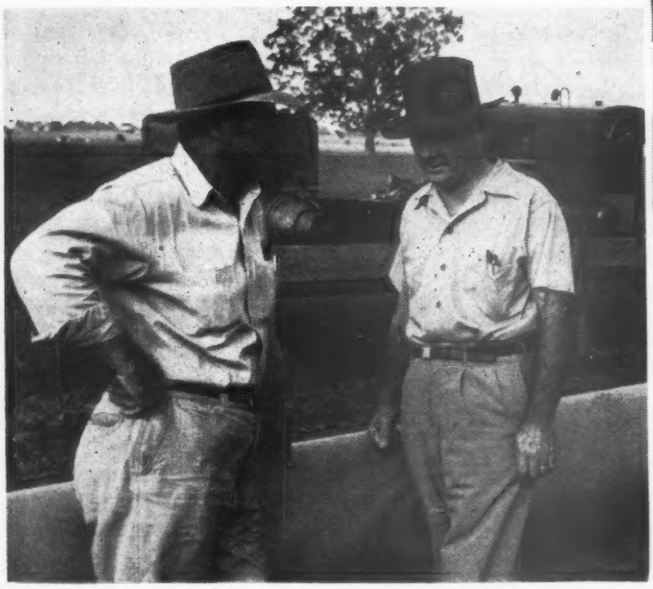
Pipe Lines at the Agha Jari oil field, Southwest Iran.

Wrapped pipe being pulled across Red River near Shreveport, Louisiana, on Arkansas Louisiana Gas Company's new line.

Lincoln welders lined up on Midwestern Constructors spread of Transcontinental Pipe Line.

These H. C. Price Company employees pause long enough to pose for photographer on Tennessee Gas Transmission Company's Buffalo extension. Athel Bell, lower-in foreman; Abe Reutzel, spread superintendent; Buck Luther, TGT inspector. Beside the truck are: Jack Ingram, chief mechanic; Sid Wood, coating foreman; R. W. Orr, welding foreman.

Bill Watson, spread inspector, and Russell Brannon, supervising corrosion engineer, taken during construction of Humble's West Texas-Gulf Coast line.



Lining up pipe on Houston Contracting Company spread of the Mid-Valley Pipeline Company system.

With the PIPE LINE CONTRACTORS

Williams Brothers Corporation, National Bank of Tulsa Building, Tulsa, Oklahoma, is now at work on 707 miles of loops to the Plantation Pipe Line Company system. The line is from Baton Rouge, Louisiana, to Charlotte, North Carolina. The pipe will be 18-in. between Baton Rouge and Bremen, Georgia, a distance of 432 miles, and 14-in. from that point to Charlotte, a distance of 275 miles.

H. C. Price Company, Pipe Line Division, Box 1111, Bartlesville, Oklahoma, has the general contract covering construction of 373 miles of 26-in. high pressure natural gas pipe line for Tennessee Gas Transmission Company from the north bank of Ohio River, east of Portsmouth, Ohio, northeastward to near Buffalo, New York. Work on the initial section of nearly 220 miles through Ohio has been completed; work on 153-mile section through Pennsylvania and New York was 98 per cent completed as of December 10 and completion expected within a few days. Spreads are located as follows:

Corry Pennsylvania: G. A. Reutzel, superintendent; W. E. Yount, office manager; and these foremen: J. A. Hairston, right-of-way; L. J. Loncarich, ditch; J. C. Anderson, bending; H. C. Morrison, pipe; K. N. Adkins, pipe; R. W. Orr, welding; S. J. Wood, coating; A. L. Bell, lower-in; T. E. Walker, clean-up.

Dunkirk, New York: R. K. Shivel, superintendent; R. E. Burgess, office manager; foremen: J. D. White, right-of-way; W. H. Olrich, ditch; J. H. Latham, bending; C. E. Shivel, pipe; R. L. Ezell, welding; U. M. Beaver, coating; G. E. Beaver, lower-in; Sam Price, clean-up; Ray Drewell, crossing.

Another general contract covers construction of approximately 480 miles of main transmission line for Texas Illinois Natural Gas Pipeline Company from near Refugio, Texas, northeastward to the Texas-Arkansas state line near Texarkana. Work on 36 miles of 24-in. extension to Old Ocean field near Hungerford has been completed. Work on 110 miles of the main 30-in. pipe line between Hungerford and Texarkana was 98 per cent completed as of December 10. The contract also includes 38 miles of 12-in., 97 miles of 26-in., and an additional 200 miles of 30-in., plus multiple crossing of Trinity River. The 12 and 26-in. sections have been subcontracted to Western Pipeline Constructors, Inc. Spreads are located as follows:

Wharton, Texas: W. B. Williams, superintendent; P. O. Rutledge, office manager; foremen: R. H. Edwards, right-of-way; D. L. Beachy, right-of-way; K. K. Kelly, ditch; Roy Stegall, bending; J. I. Cobb, pipe; C. F. Jones, welding; Rube Owens, coating; A. D. Hamilton, lower-in; Fred Williams, clean-up.

Tomball, Texas: C. R. Ice, superintendent; G. A. Harvey, office manager; foremen: John E. Hamilton, right-of-way; Jessie Cash, right-of-way; E. W. Whisenant, ditch; Forest Loinette, bending; W. T. Dickerson, pipe; L. O. Reutzel, welding; N. D. Adams, coating; J. C. Rich, lower-in; E. D. Worley, clean-up.

Texas-Louisiana Construction Company, 804 Dan Waggoner Building, Fort Worth, Texas, had finished 30 miles (December 15) of the 50 miles of 30-in. being laid for United Gas Pipe Line Company from Missouri City to a point near Wharton, Texas. Two spreads are employed. One has its headquarters at Rosenberg, with "Borger Red" McMenamy as superintendent. The other is working out of Wharton, where Jimmy Reid is in charge. Pat Rogan is office manager at Wharton and Robert Yater at Rosenberg.

Sheehan Pipe Line Construction Company, 529 National Bank of Tulsa Building, Tulsa, Oklahoma, completed its work for Southern Natural Gas Company during December. An 180-mile, 18-in. line was laid from Gwinville, Mississippi, to Selma, Alabama, and a 32-mile, 16-in. line from Wetumpka to Tallassee, Alabama.

Cheek Construction Company, Inc., P.O. Box 491, Ulysses, Kansas, completed laying the latter part of December 151 miles of 6-in. products pipe line between LaJunta and Denver, Colorado, for the Phillips Petroleum Company. The last field office was at Aurora. Troy Cheek was superintendent, J. E. Cheek office manager, Alton Cheek pipe foreman, and A. W. Charpiot dope foreman.

Arabian Bechtel Corporation, 220 Bush Street, San Francisco, California, has begun construction of Iraq Petroleum Company's 566-mile system from the Kirkuk field in northern Iraq to Banias on the Mediterranean seaboard. Clark Rankin, Bechtel vice president, is project manager.

Trojan Construction Company, Inc., P.O. Box 4427, Oklahoma City, Oklahoma, has completed 80 per cent of the 284 miles of 6⅝-in. line it is laying for Tri-States Pipe Company between Hagerstown, Indiana, and Charlestown, Ohio (December 14). The field office is at Galion, Ohio, where W. E. "Slim" Deaver is superintendent and Walter Wells office manager.

The 50 miles of 8⅝-in. for Humble Oil and Refining Company between Longview, Texas, and the Trawick field is 90 per cent completed. C. T. "Swede" Tillotson is superintendent and Don Wilson in charge of the field office, which is at Henderson, Texas.

The contractor recently completed laying 40 miles of 10-in. for Shell Pipe Line Corporation near LaGrange, Texas.

Work has not yet begun on the Oklahoma Natural Gas Company Contract, which calls for the laying of 93 miles. Between Edmond and Depew, Oklahoma, 53 miles of 26-in. will be laid and from Ninnekah to County Line, Oklahoma, 40 miles of 16-in. Crews for this work have not yet been organized.

Anderson Brothers Construction Company, 707 Drennan Street, Houston, Texas, is working out of its field office at Liberty, Texas, on the 174-mile section it is laying for Trunkline Gas Supply Company between Garwood and Sabine River.

Also for Trunkline, 127 miles of 26-in. is being laid from Greenville to Senatobia, Mississippi. The crew under Lewis Knox is working from Greenville.

Between Longville, Louisiana, and the Sabine River, 42 miles of 26-in. is being laid for Trunkline under the supervision of Dick Jernigan. The field office is at DeQuincy, Louisiana.

Smith Contracting Corporation, 205 Northwest Seventh Street, Fort Worth, Texas, completed the Texas Eastern Transmission Corporation job on the Texas Gulf Coast the middle of December. This project consisted of 108 miles of 16-in. from Baytown to Provident. The work was done with two spreads under the supervision of J. H. Smith. One spread had its headquarters at Eagle Lake with Jim McKnight as spreadman and Ivan Steele office manager. At South Houston, H. E. "Shorty" Doyle was spreadman and M. E. Williams office manager.

Dunn Bros., 801 Mercantile Securities Building, Dallas, Texas, are engaged in stringing 471 miles of pipe for H. C. Price Company on the Texas Illinois Natural Gas Pipeline Company project, as follows:

Section 2—100 miles of 26-in. from Refugio to Glenflora, Texas.

Section 3—36 miles of 24-in. from Old Ocean, Texas, to the main line, and 36 miles of 12-in. from Chocolate Bayou to the main line.

Section 4—109 miles of 30-in. from Glenflora to Urbana, Texas.

Section 5—91 miles of 30-in. from Urbana to Dotson, Texas.

Section 6—99 miles of 30-in. from Dotson to the Texas-Arkansas state line.

Other jobs being strong by the company are as follows:

El Paso Natural Gas Company—415 miles of 24-in. between Fruitland, New Mexico, and Yucca, Arizona. (San Juan line.)

El Paso Natural Gas Company—419 miles of 30-in. in New Mexico, Texas, and Arizona.

O. R. Burden Construction Company, Box 5216, Tulsa, Oklahoma, was recently awarded a contract, and already has begun work, on 56.5 miles of 10¾-in. pipe line for The Texas Pipe Line Company between Lawrenceville, Illinois, and Mount Vernon, Indiana. It will parallel Texas' 6-in. line now in operation. A field office has been opened at Mount Carmel, Illinois, where Pete Hiner is spread superintendent.

Completed in December was 51 miles of 6 and 8-in. for Phillips Pipe Line Company between Sweeny and Webster, Texas. Barney Hall was superintendent over the job and Howard Smith manager of the field office, which was at Alvin.

Houston Contracting Company, Houston, Texas, has the following construction work under contract:

For Trunkline Gas Supply Company. 130 miles 26-in. gas line from the vicinity of Epps, Louisiana, to Hineston, Louisiana. E. C. Norris, superintendent; R. J. Axsom, office manager. Present headquarters are at Alexandria, Louisiana. Approximately 115 miles completed to December 15.

Forty-four miles of 26-in. for Trunkline from vicinity of Longville, Louisiana, northeast to vicinity of Hineston. W. H. Hayes superintendent; J. C. Strickler and J. B. Stoddard, office; present headquarters, DeRidder, Louisiana. Approximately 35 miles completed.

Also for Trunkline 33 miles 20-in. from the vicinity of Longville to vicinity of Lacassine, Louisiana. F. A. Silar, superintendent; C. V. Oliver and L. F. Redfearn, office; headquarters, Kinder, Louisiana. Job was completed December 20. Another job recently completed for Trunkline was 18 miles 16-in. from Lake Arthur, Louisiana, to vicinity Lacassine. H. L. Leake was superintendent; S. B. Harrison, office manager; headquarters, Welsh, Louisiana.

Two 16-in. gas lines across the Mississippi River for Tennessee Gas Transmission Company in the vicinity of the Greenville, Mississippi bridge. were completed December 20. H. E. Murphy, superintendent; J. J. Nolan, office manager; headquarters, Greenville, Mississippi.

Midwestern Constructors, Inc., 105 North Boulder Street, Tulsa, Oklahoma, is devoting its entire attention at the moment to work on the Texas Illinois Natural Gas Pipeline Company system. The jobs are as follows:

Schedule 1 — Approximately 100 miles of 26-in. from LaGloria to Refugio, Texas. Field office: Kingsville, Texas. Superintendent: M. T. Wilhite. Spreadman: Denver Franklin. The job was 35 per cent completed December 12.

Schedule 11—Approximately 100 miles of 30-in. from the Mississippi River near Chester, Illinois to Effingham, Illinois. The field office is at DuQuoin. M. T. Wilhite is superintendent and John Work spreadman. The job has been shut down for the winter with the work 28 per cent completed.

Schedule 12—Approximately 100 miles of 30-in. from Effingham to Sibley, Illinois. Work scheduled for 1951.

Schedule 13 — Approximately 92 miles of 30-in. from Sibley to Joliet, Illinois. Scheduled for 1951.

The crossing of the Illinois River near Morris, Illinois, is approximately 40 per cent completed. The field office is at Morris. Clyde Peters is superintendent and Bill Daniels office manager.

Western Pipeline Constructors, Inc., Austin, Texas, are laying 97 miles of 26-in. and 38 miles of 12-in. in Texas for the Texas Illinois Natural Gas Pipeline Company.

Texas-Southern Contracting Company, 804 Dan Waggoner Building, Fort Worth, Texas, completed just before Christmas the laying of 24 miles of 16-in. pipe for United Gas Pipe Line Company from Cameron Parish, Louisiana, to the Gulf refinery at Port Arthur, Texas, as well as lines inside the refinery. F. O. "Banty" Traweek was superintendent and Q. B. Davis, Jr., office manager.

Percy Jones, Inc., 1131 North Eastern, Oklahoma City, Oklahoma, is stringing approximately 10 miles of 12¾-in. of pipe for Kaw Pipe Line Company for a gathering system near Russell, Kansas. The pipe is being hauled from Texas and Oklahoma. The job started December 14.

In progress also is the hauling of 8½ miles of 16-in. from points in Kansas to a point near the Missouri-Oklahoma line for Cities Service Gas Company.

Williams-Austin Company, Grant Building, Pittsburgh, Pennsylvania, plans to complete about February 1. 42 miles of 20-in. for Central Kentucky Natural Gas Company, which it is laying from the North Means compressor station to Foster, Kentucky. Leman Creech is spread superintendent and L. A. Franks and R. H. Condry timekeepers.

The New York State Natural Gas Corporation job is just being completed. This consists of 21 miles of 20-in. from Tonkin station to Bakerstown, Pennsylvania. Ralph Gaddy and Howard Bauer are superintendents and E. E. Mayes timekeeper.

Ed Peters is general superintendent over all work.

Parkhill Truck Company, P.O. Box 1856, Tulsa, Oklahoma, is stringing 217 miles of 24-in. for Anderson Brothers Construction Company on Trunkline Gas Supply Company job from Longville, Lousiana to Garwood, Texas. Work began October 22.

Other jobs are: For Houston Contracting Company, 176 miles of 26-in. on Trunkline between Longville and Darnell, Louisiana. Foremen are F. L. Bridges and O. C. McCoy.

For Midwestern Constructors Inc., on Texas Illinois Natural Gas Pipeline 100 miles of 26-in. from La Gloria to Refugio, Texas. Harold Deatherage is foreman. Job started October 18.

Sections 7, 8, 9, and 10 on the Texas Illinois for Bechtel Corporation, 417 miles of 30-in. from Texarkana, Arkansas, to the Mississippi River near Cape Girardeau, Missouri. Foremen: Charles Sampson on Section 9; Jimmie Stubblefield 7.

Sections 11, 12, and 13 on the Texas Illinois job, for Midwestern Constructors, Inc., 300 miles of 30-in. from the Mississippi River near Cape Girardeau to Joliet, Illinois. Curtis Williams is foreman.

For Anderson Brothers on Trunkline system, 180 miles of 26-in. from Darnell, Louisiana to Senatobia, Mississippi. The foreman is Ira Gould.

For Bechtel Corpartion, 54 miles of 20-in. from Wood River to Patoka, Illinois. Ray Herron is foreman.

J. L. Cox and Son, Raytown, Missouri (stringing contractors), have completed stringing approximately 80 per cent of the 51 miles of 12-in. from Paola, Kansas, to the Kansas River for the Great Lakes Pipe Line Company.

Work began November 15 on picking up 180 miles of 6 and 8-in. pipe for The Texas Pipe Line Company between Chico, Texas, and Fort Worth, and between the latter point and Ranger.

In January a start will be made on stringing 56 miles of 10-in. near Griffin, Indiana, for The Texas Pipe Line Company.

Pipe is being unloaded now for the Platte Pipe Line Company. This is 20-in. that will be laid from Lysite, Wyoming, to Wood River, Illinois.

Vaughn and Taylor Construction Company, Inc., Box 1351, Wichita Falls, Texas, is laying a 133-mile low pressure gas gathering system in Snyder County, Texas, for Sunray Oil Corporation. The system will serve the company's Snyder gasoline plant. Size of pipe is from 3 to 30-in. D. D. Vaughn is superintendent.

A gas gathering system is being laid in the Sherman field, Texas, for Phillips Petroleum Company, the pipe varying from 3 to 16 in. diam. This project involves 99 miles of pipe.

Associated Pipe Line Contractors, P.O. Box 2163, Houston, Texas, has completed 45 miles (to December 18) of 16-in. between Tuskegee, Alabama, and Columbus, Georgia, for Southern Natural Gas Company. The entire section consists of 121 miles. Lacy Walker is spreadman and Buck Johnson office manager.

Another job underway for Southern Natural is 40 miles of 18-in. from Selma to Elmore, Alabama. L. H. Gray is in charge of this work with James Luther managing the office. Twenty miles have been completed.

Bechtel Corporation, 220 Bush Street, San Francisco, California, has work in progress on three spreads for Texas Illinois Natural Gas Pipeline Company. The Arkansas and Missouri portions of the system are being laid, consisting of 409 miles of 30-in. Headquarters for the spreads are as follows: Newport, Arkansas, where L. E. Richardson is spread superintendent; Texarkana, Arkansas, with V. L. Williams superintendent, and Poplar Bluff, Missouri, where A. M. Berlander is in charge. The project office is at 409 East Markham Street, Little Rock, Arkansas. E. W. Davis is division manager, E. J. Hayes division office manager, and E. C. Elting project office manager.

Another job in progress is 54 miles of 20-in. crude oil line for Ohio Oil Company in Illinois. The office is at 600 13th Street, Highland, Illinois. S. D. Bechtel, Jr., is superintendent and W. H. Molander office manager.

R. H. Fulton and Company, Box 1526, Lubbock, Texas, is laying 155 miles of 20-in. between Jetmore and Bushton, Kansas, and 73 miles of 26-in. from Concordia to Salina, Kansas, for Northern Natural Gas Company. Jerry Nash is superintendent in charge of the former job, and M. L. Boyd of the latter.

Work also is under way on 184 miles of 26-in. for Trunkline Gas Supply Company between Senatobia, Mississippi, and Joppa, Illinois. Ed Veach is superintendent and Bill Gray field office manager.

Clark Williams is general superintendent over all three jobs.

Fulton and J. T. Brodie, as a joint venture, are laying 264 miles of 20-in. for Trunkline from McAllen to Altair, Texas. J. T. Brodie is in charge of the work. The field office is at El Campo.

A contract has been taken for laying 56 miles of 12¾-in. pipe between Wichita Falls, Texas, and the Chico pump station in Wise County for The Texas Pipe Line Company.

H. C. Price Company, Somastic Division, is doing the following work:
Philadelphia plant operations—

Sun Oil Company—Application of Somastic coating to 2100 ft of 8⅝-in. OD pipe.

Phelps-Dodge Corporation—Application of coating and internal cleaning and coating to 55,500 ft of 5 9/16-in.

Susquehanna Pipe Line Company—Application of coating to 5000 ft of 6⅝-in. OD pipe.

Philadelphia Electric Company—Application of coating to 64,750 ft of 16-in. OD pipe and 1000 ft of 20-in. OD pipe.

Philadelphia Gas Works Company—Application of coating for all pipe requirements for the year 1950.

New Orleans plant operations—

United Gas Pipe Line Company—Application of coating to aproximately 66,000 ft of 6⅝-in. OD pipe; 42,000 ft of 8⅝-in. OD pipe; 35,500 ft of 10¾-in. OD 0.307 wall pipe; 3500 ft of 10¾-in. OD ½-in. wall pipe; 52,800 ft of 12¾-in. OD pipe; 47,500 ft of 16-in. OD ¼-in. wall pipe; 322,000 ft of 16-in. OD 5/16-in. wall pipe; 14,500 ft of 16-in. OD ½-in. wall pipe.

United Gas Pipe Line Company—Application of coating to approximately 3500 ft 8⅝-in. and 7000 ft of 10¾-in. OD pipe.

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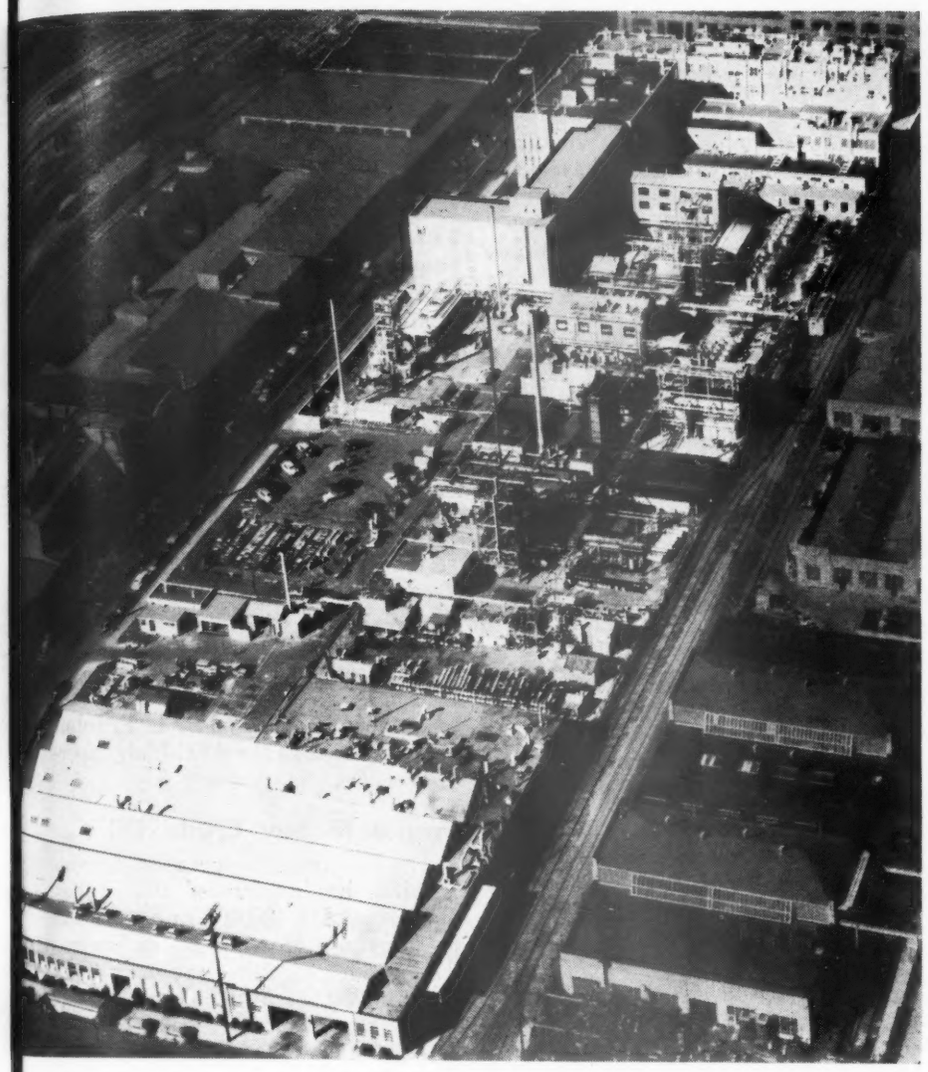


Air view of Shell research plant at Emeryville, California.

Research in the Modern Manner

RICHARD SNEDDON*

SHELL Development Company's recently enlarged research facilities at Emeryville, California, including a new 4-story building, provided the occasion for an interesting open house on November 21, 1950, during which a section of the press, following a trip through the plant, met with H. S. M. Burns, president of Shell Oil Company, and several members of the board of directors.

The program was opened with a short word of welcome by Jack Sembower, director of public relations, who, after explaining the pending sequence of events, turned matters over to M. S. Spaght, president of Shell Development. Spaght outlined briefly the history of the company; gave some idea of its scientific and administrative accoutrement, and defined the accomplishment and function of research generally and Shell research in particular.

Spaght expressed the belief that really concentrated petroleum research had its beginning immediately after World War I. The development of the internal combustion engine had prior to that time emphasized the advantages of liquid fuel, and the subsequent parallel progress of the engine and the fuel constitute a pretty familiar chapter in our industrial history. Today liquid fuels supply more than half the energy requirement of America. If the total production of petroleum products were burned, the release of heat would be approximately 30,000,000 Btu's, equivalent in power output to 350 Hoover Dams. Also, it is to be noted that crude oil as produced contains on the average about 20 per cent of material that can qualify as gasoline, but a long line of technical accomplishments, including such processes as thermal cracking, catalytic cracking, alkylation, polymerization, hydrogenation, isomerization, etc., have enabled the oil industry to market some 44 per cent of its present crude production as gasoline.

By the end of World War II, America was producing over 500,000 bbl a day of aviation gasoline of which most of the ingredients were synthetic, and by virtue of which we found it possible to build superior aircraft engines. The gasoline research still proceeds apace. An outstanding discovery since the last war is a new catalytic reforming process from natural gasolines, that increases both the volume and quality of gasoline yield per volume of crude. Shell recently announced the prospective construction of 2 units incorporating this process. They will be the first of their type in the U. S.

At the turn of the century Germany led the world in the synthesis of certain types of organic chemicals that were either commercially unavailable or very difficult to secure. During World War I, however, the U. S. took up with vigor the manufacturing of organic synthetics—largely at first from coal tar or derivatives of the fermentation of natural substances like molasses and grains. Later the low boiling fractions of petroleum became recognized as a vast source of cheap but extremely versatile raw material.

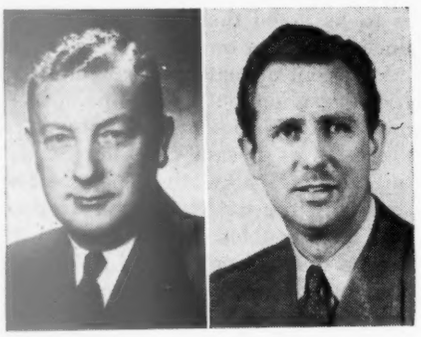
In this departure, Shell Development has been an outstanding pioneer. Among the many products that come under the classification of petro-chemicals are synthetic alcohols, ketones, resin and plastic intermediates, glycerine, ammonia, and lubricating oil additives. The latter, along with isooctane and toluene have been commercially produced for some time. The laboratory at Emeryville has perfected methods of synthesizing ethyl

Continued on Page E-6

*Pacific Coast Editor.

alcohol, glycerin, epichlorohydrin, diallyl phthallate, di-tert butyl peroxide, and a number of other important chemicals.

The Development Company as a whole has designed several very successful refining processes. These include the solutizer process for removing sulfur compounds from gasoline, and the phosphate treater process for removing hydrogen sulfide from gases. Others deal with alkylation,



H. S. M. Burns, left, is president and director of Shell Oil Company; Dr. M. E. Spaght, president of Shell Development Company.

isomerization, microspheroidal catalytic cracking, oil base drilling muds, the production of butadiene, penicillin recovery, toluene recovery, and pipe line corrosion inhibition.

Shell Development employs more than 1100 people, including scientists of every conceivable type from 135 American and 13 foreign universities and colleges.

In the photographic department there were automatic photostaters and a camera that metaphorically flattened pistons and cylinders and depicted their entire surfaces as rectangles. In the radioactivity lab with its diversity of Geiger counters we examined glass fused from the sands of New Mexico in the first A-bomb test and still radioactive after 5 years.

Most interesting indeed were the plastics labs where the molding properties, working properties, and effects of additives are determined. A rubber tester that is used here captivated the interest of everyone. In it a series of rubber balls are dropped from a common hopper and thence bounce their zigzag paths over a number of angled surfaces—the path in each case being determined by the resiliency of the rubber. Industry in its entirety now spends something like a billion dollars a year on research according to Spaght, and the end is not yet. Following the tour, we met the president of Shell Oil, H. S. M. Burns, and several members of the board of directors as well as many of the West Coast executives.

Burns announced the company's plan to inject new life into several old California oil fields, notably Ventura and Brea. Extensive studies have led to the belief that because of the inadequacy of early drilling and completion techniques, the realization from certain proven areas was not all it might be. In addition, continuous studies of these areas has revealed pertinent factors not originally taken into consideration. These findings, plus improved equipment, technique, and general understanding have stimulated Shell Company to a program that will require the drilling of several hundred new wells in these areas. Needless to say, all related activities are being similarly subjected to the closest of scrutiny, and the general plan projects also an increase of pace in manufacturing, marketing, and fields of research other than those already mentioned.

French Refinery Output Adequate for Her Needs

The first report on the French petroleum industry has been presented by M. Robert André, president, Union Des Chambres Syndicales de l'Industrie du Petrole in Paris. André stressed the importance of the country's refining industry, which is the first to be established in Europe. Largely destroyed during the war, it has now been constructed to provide for all France's needs. From 1939 to 1952, France will have increased its production from 8.2 to 18.8 million metric tons, and in the same period, U.K. refinery capacity will have risen to 19.4 million metric tons from 3.4. André stressed the value of the French natural gas industry, adding that production at St. Gaudens brought in about 3 millards francs a year to the state, value of the concession could be gaged at more than 30 millards.

The 64-page report, "L'Industrie Française du Petrole, 1950" is illustrated in color, deals with every aspect of the industry, and contains much up-to-date statistical information not previously available in such a comprehensive form.

Carnegie Laboratory Opened

Carnegie Institute of Technology, Pittsburgh, Pennsylvania held the first public inspection of a new petroleum research laboratory recently. The new laboratory is headed by Dr. Frederick D. Rossini, nationally-known research scientist. Dr. J. C. Warner was inaugurated as fourth president of Carnegie and the 50th anniversary of the institution was celebrated.

Phillips Will Operate Material Testing Reactor

Phillips Petroleum Company has been named by the Idaho operations office of the Atomic Energy Commission as the operator of a new materials testing reactor being built in southeastern Idaho. The appointment is subject to completion of contract negotiations now in progress. The new multi-million dollar reactor is situated on the Snake River plains west of Idaho Falls. It is one of three different types of atomic reactors now being constructed at the Idaho site.

Primary purpose of the new reactor will be to test materials that may be used in future reactor construction. In addition, the experience gained by opration of this compact high radiation density reactor with its new features of design, will be of immediate value to reactors still on the drawing board. Phillips was selected after detailed consideration of 34 firms, according to a statement released by L. E. Johnston, manager of the AEC Idaho operations office.

France to Buy Crude Oil

The Economic Cooperation Administration has announced that it has authorized $14,480,000 to France for the purchase of crude oil and petroleum products. Authorizations include $11,230,000 for Middle East oil, $3,280,000 for oil in the Caribbean area, and $330,000 in U. S. and possessions.

Petroleum Congress Will Elect Council Chairman

The organizing committee of the Third World Petroleum Congress announces that due to the sudden death in Paris on September 18 of Colonel L. Pineau, chairman of the Permanent Council, a new chairman will be elected in the near future. Frank M. Porter, president of the American Petroleum Institute, has accepted the invitation to be a member of the Committee of Honour for the Third World Petroleum Congress.

Shell Movie Wins Award

A 20-minute color movie that makes a complex financial story understandable to all employees has won an award for Shell Oil Company in the Associated Industries of Massachusetts third annual contest for annual reports. Called "The story of Shell in 1949," the movie is based on the company's annual report to stockholders. It received a special award for "originality of presentation" because of its fresh approach to the job of telling the company's financial story in a simple and clear manner.

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• **Double Reinforcing Wire Units**—Royal 4 incorporates 2 double wire layers (4 stress wires in all) to a unit—each layer with sufficient hydrostatic value to resist bursting should the other become damaged—each a hose in itself.

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NEWS

Mexico's 1950 Oil Output To Be Highest Since 1926

Mexico's crude oil production for the first 9 months of last year totaled 53,333,722 bbl, a 21.5 per cent gain over the 43,879,846 bbl produced in the same period of 1949, Sen. Antonio J. Bermudez, Pemex head, has reported. This will make Mexico's 1950 output the greatest since 1926, Bermudez declared. Natural gas production in the first 9 months of 1950 increased nearly 28 per cent, amounting to 8,863,496 bbl. Total production, including crude oil, distillate, and natural gas amounted to 62,220,516 bbl in the 9-month period.

Bermudez also stated that refinery runs totaled 44,292,997 compared with the 43,126,846 bbl for the corresponding period of 1949. The number of wells drilled, 135, was a 20 per cent increase over the 9-month period of 1949. Footage drilled in the 1950 period was 528,832 ft, or about 11 per cent more than for the first 9 months of 1949.

Mexican Research Institute

Collaboration by Southwest Research Institute with directors of the Monterrey Institute of Technology in creating a non-profit industrial research institute in Mexico was announced at Southwest Research Institute's annual trustees meeting. The San Antonio research institute thus further expanded its international activities, which already include projects in Brazil, France, Cuba, Italy, and Mexico.

The new Mexican industrial research unit will be governed by the board of directors of the Monterrey Institute of Technology and operated independently of, but in close collaboration with Mexico's M.I.T., thereby enhancing the educational programs of the Monterrey Institute.

ASM Devotes Session to Oil

The oil industry will be the subject of one session of the American Society for Metals' 7th Western Metal Congress and Exposition, in Oakland, California, March 19-23. Earl R. Parker, University of California and head of the committee planning the technical program, has reported that George Nelson, Shell Oil Company, will speak on "Properties and Applications of Commercial Alloys" in the oil industry. Ralph Wilson, director of research, Timken Roller Bearing Company, will deliver a paper on "Trends in the Development of Special Alloys Applicable to the Oil Industry."

Oil Storage Facilities

Acording to a study made by the National Petroleum Council, only a third, or about 80,000,000 bbl of crude oil stored in the U. S. is available for immediate use. The study, which was based on conditions prevailing on June 30, stated this would amount to about 14 days supply for U. S. refinery operations.

About 17 per cent of the total crude supply is in transit, and another 100,000,000 bbl is needed to assure continuous operation of pipe lines, refineries, and handling and blending of the many grades of crude processed in this country.

Crude oil storage capacity in the U. S. totaled 432,318,00 bbl on June 30, with 10,000,000 due to be added by the year's end. The NPC report explained that a great deal of this tankage is not in areas where it can be used, and some of it is not "susceptible to re-location elsewhere because of its condition."

Research Club Formed

The Texaco Research Club, affiliated with the Scientific Research Society of America, has been organized at the Beacon Laboratories of The Texas Company at Beacon, New York. It is composed of 51 technical employees of Texaco's Beacon Laboratories. This is the seventh such organization to become affiliated with RESA, the industrial counterpart of Sigma Xi.

Donald B. Prentice, national director of RESA, presented the club charter to Harry M. Allred, president, at the club's first meeting.

Waste Products Used

An outstanding conservation project undertaken by the oil and gas industry in the new Worland, Wyoming oil field will result in an estimated $2,500,000 a year in additional cash plus full use of formerly wasted by-products, Secretary of Interior Oscar L. Chapman has announced. The Pure Oil Company, The Texas Gulf Sulphur Company, and the Montana and Wyoming Pipe Line Company will construct a 12¾-in. pipe line between Worland, and Baker, Montana, a sulfur extraction plant, a gasoline plant, and a compressor station, representing a capital investment of about $15,000,000. In this manner, the companies can make full use of all the field's resources, rather than the oil alone.

Chapman added that under the Worland unit agreement, the oil companies have made a larger capital outlay, but stand to gain added profit from the marketing of formerly wasted products.

Synthetic Fuel Plants Able to Produce Chemicals

Synthetic fuel processes can play an important part in meeting requirements for strategic chemicals used in the manufacture of essential products, James Boyd, director of the U. S. Bureau of Mines, stated at the 1950 annual meeting of the American Society of Mechanical Engineers in New York City. A Bureau of Mines study has determined that a coal-hydrogenation plant could be operated in such a manner that the yields of benzene, toluene, and xylenes would be increased by about 25 per cent. Boyd added, however, that this would result in a proportionate reduction in the yield of gasoline. Shale oil contains significant amounts of aromatic chemicals now in short supply, said Boyd. The B of M has demonstrated in a laboratory unit that benzene and toluene can be obtained from oil shale by a radiant retorting process. If this same process is commercially feasible in large-scale equipment, the yields of these two chemicals would be "very impressive."

In surveying the U. S.'s fuel supply, Boyd stated the reserves of petroleum are relatively limited. The present decade is one in which authorities in both the petroleum industry and government have indicated that domestic petroleum production probably will pass its peak and may begin to decline. "Barring unexpected developments in atomic or solar energy, the anticipated gap widening between domestic demand and supply will have to be met by synthetic liquid fuels and imports."

Sun Oil Case Dismissed

Judge J. Joseph Smith in an opinion filed with the U. S. District Court, has dismissed the suit of the Meriden Retail Gasoline Dealers Association against Sun Oil Company and four of its dealers, pointing out that the plaintiff had failed to establish any violation of law. The defendant dealers, the decision said, are "independent local merchants" free to set their own retail prices and are not agents of the distributor as alleged in the complaint against them.

Judge Smith denied the request of the association for an injunction to restrain Sunoco dealers in the Meriden area from lowering their prices to motorists and Sun Oil from reducing its prices to the dealers. Coupled with the request for an injunction was a claim for treble damages totaling $150,000. In dismissing the action, the court ruled that the association failed to prove that prices in the Meriden area were unreasonably low in view of prices prevailing in nearby areas.

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U. S. Imports Reported

The figures below represent U. S. imports of crude oil and petroleum products during the week ended December 9 and the 4 weeks period ended that date, as released by the American Petroleum Institute. Figures are based upon reports from all of the so-called major importers who are primary foreign suppliers or refiners, as well as some of the other importers, and include 75,000 bbl per day to cover non-reporting companies, the API stated.

IMPORTS

(Figures in Barrels per Day)

	Crude Oil	Residual Fuel Oil	Distillate Fuel Oil	Asphalt	Others	Total
Week ended December 9	411,300	382,900	—	3100	20,200	817,500
Average per week for four weeks ended Dec. 9	454,800	401,400	4100	5800	20,100	886,200

Stanolind To Build New Research Center

Stanolind Oil and Gas Company will soon begin construction of a new research center in Tulsa, Oklahoma. Preliminary plans have been completed, and the company is preparing to go ahead with the project. The site chosen for the center is an 80-acre tract on the south-west corner of the intersection of 41st street and Yale Avenue, land that was purchased by Standolind in 1948, when the proposed research center was first announced. It is contemplated that construction will be begun next spring if materials are available and if no further restrictions are placed on building because of the defense program. The new center will house the staff of more than 300 employees.

Architects on the project are Shreve, Lamb and Harmon Associates of New York, who are specialists in the design of research laboratories. The firm drew up the plans for new laboratories built by a number of outstanding companies prominent in the radio, oil, building materials, electrical supplies and rubber industries.

Sinclair Will Award Four New Fellowships

Four $2500 fellowships will be awarded to outstanding graduate students by the Sinclair Refining Company for research in the fields of chemistry, geology, and petroleum production. Fellowships in the field of organic chemistry have been established at the Universities of Chicago and Illinois. A Sinclair fellowship in petroleum geology has been awarded to the Colorado School of Mines, while research in petroleum production engineering will be conducted at the University of Oklahoma.

New Bank Building Begun

Ground breaking ceremonies marking the beginning of construction on the new Republic National Bank building were held in November at the new building site in Dallas, Texas. President Fred F. Florence started a huge dragline, which scooped the first dirt from the ground.

The new $17,500,000 Republic building will rise a total of 600 ft above the ground. Various Dallas civic and business leaders spoke at the ceremony.

AIME Elects 1951 Officers

New officers for 1951 of the North Texas section of the American Institute of Mechanical Engineers are: Jack Crichton, DeGolyer and MacNaughton, chairman; K. Marshall Fagin, The Petroleum Engineer, vice-chairman for Dallas; Gus Athanas, Stanolind, vice-chairman for Fort Worth; Earl C. Taylor, Jr., Gulf, vice-chairman for Wichita Falls, and Kenneth Anderson, U. S. Bureau of Mines, secretary-treasurer.

Directors of the section are: W. E. Stiles, Ken Corporation, Dallas; Pat Reardon, Gulf, Fort Worth; R. G. Parker, Continental, Fort Worth; Joab B. Harrell, Jr., M. E. Daniel (producer), Breckenridge, and Gordon R. Stine, Cable and Stine, Wichita Falls.

Dallas committees chairmen include the following: Program committee, Barney Wharton, Atlantic; publicity, R. P. Brooks, Times Herald; hospitality and entertainment, Bob Seale, Schlumberger; membership, Ted Nelson, Magnolia, and journal secretary, John Jacob, Nebo Oil Company.

Oklahoma Sets Own Natural Gas Prices

The U. S. Supreme Court has upheld the Oklahoma Corporation Commission's decision that the state has the authority to fix prices for natural gas at the wellhead. The price of Hugoton gas from Oklahoma has been set at 7 cents at the well. It has been as low as 3 or 4 cents. The court ruled that the wellhead price of gas as herein set may have little effect on the domestic consumer's prices. Evidence was cited that the "commercial heat value" of natural gas was in excess of 10 cents per 1000 cu ft at the wellhead (at the time that the 7 cents minimum was set).

Committee to Raise Funds

Samuel Messer, president of Quaker State Oil Refining Corporation, has been named to a 6-man committee to assist in raising a million dollar fund to complete enlargement of Drake Well Memorial park and museum at Titusville, Pennsylvania in time for observance in 1959 of the first commercial oil well's 100th anniversary. The other 5 men, appointed by C. E. Streeter, president of the Pennsylvania Grade Crude Oil Association, are: C. L. Suhr, chairman of the board of directors of the Pennzoil Company; Fayette B. Dow, Washington, D. C., Association vice president and general counsel; H. A. Logan, Warren, Pennsylvania, United Refining Company; John P. Herrick, oil producer of Olean, New York, and Los Angeles, California, and J. Hanks of Bradford, Pennsylvania, president of South Pen Oil Company.

Eastern Oil Prices Up

The price of all grades of Pennsylvanian oil with the exception of Zanesville crude, have been increased 15 cents a barrel, the Joseph Seep Agency of the South Penn Oil Company has announced.

The new prices are:

Bradford	$4.25
Allegheny	4.25
Middle District	4.25
S. W. Pennsylvania	3.82
Virginia	3.76
Ohio	3.76

This is the sixth straight time in 1950 that prices have been increased, making a total of 75 cents. On May 1, prices were upped 11 cents; on June 21, 10 cents; On August 25, 11 cents and on October 9, 10 cents. George J. Hanks, president of South Penn Oil Company, annouced that the price increase was made necessary because the refiners heavy demand still continues and justifies an increase of 15 cents at this time.

On the West Coast, Standard Oil Company of California has announced increases in the prices it pays for crude oil, ranging from a few cents a barrel to 25 cents for heavy.

Socony-Vacum Oil Company, Incorporated has announced the price of its crude oil now being brought across Arabia in the 1000-mile long pipe line to Sidon, Lebanon as $2.41 a bbl at the eastern terminal, f.o.b. This compares with a price of $1.75 for similar crude oil sold at Ras Tanura in Arabia on the Persian Gulf. Socony's price for good quality oil from Iraq that is piped to Tripoli, Lebanon, is also $2.41 a bbl. The company charges $1.77 for its share of Qatar crude oil.

NEWS

Standard of Cal Will Import Oil from Borneo

Standard Oil Company of California will bring in a limited amount of crude oil from Borneo because of its inability for the last several months to buy sufficient light crude in California to take care of military and civilian requirements it was announced by T. S. Petersen, president of Standard. Petersen stated the shipments still will leave Standard as a net exporter of crude from California, inasmuch as approximately 14,000 bbl daily are moved to British Columbia.

He further noted that the West Coast oil industry, with only about 15 per cent of the total U. S. refinery run, has been supplying more than 50 per cent of the bulk military requirements for petroleum supplied by the country as a whole. The United States oil industry East of the Pacific Coast has been importing about 500,000 bbl daily of crude oil as well as substantial quantities of products, assisting them to meet the military demands being made upon them, he said. The Pacific Coast has not heretofore imported either crude or products except for a few isolated cargoes.

NPC Organization Studied

Hines H. Baker, Humble Oil Company, has been appointed to head a special committee to study the organization structure of the National Petroleum Council under the National Defense Production Act. The appointment was made by Walter Hallanan, NPC chaiman. The committee will, in all probability, consider the Justice Department's position with respect to whether participation by members of an industry in the activities of industry advisory committees might make them liable for prosecution under the antitrust laws.

Oil Companies Sponsor National Rural Contest

Eight farm boys have been named as national winners of the 1950 tractor-maintenance contest at the 6th annual live power banquet in the Stevens Hotel, Chicago, Illinois. The champions, each from a different state, were awarded a $300 scholarship by 8 sponsoring oil companies. The companies are: Standard Oil (Indiana), American Oil Company, Pan-Am Southern Corporation, Stanolind Oil and Gas, Utah Oil Refining, Standard Oil of Ohio, Standard Oil of Kentucky, and General Petroleum Corporation.

Members of International Petroleum Consultants, Ltd. at the ground-breaking of the new addition to the Petroleum Consultants Building in Pasadena, California. Left to right: James B. Christie, Dr. Reńe Engel, Charles R. Dodson, Florent H. Bailly, Dr. Hans E. Thalmann and John F. Dodge.

Oil Earnings Rise 18.3 Per Cent In 1950

Cash dividends declared in 1950 by thirty major oil companies may aggregate $683,000,000, an all-time high as well as an increase of 21.1 per cent over the previous year, according to figures compiled by the petroleum department of the Chase National Bank in a financial survey of a group of companies comprising about two-thirds of the petroleum industry of the United States. The dividends represent 41 per cent of available 1950 earnings. In addition to these dividends, several companies declared stock dividends.

In arriving at the estimated earnings for 1950, deductions for income taxes are based on the rates imposed by the Revenue Act of 1950 and do not include any provision for possible excess profits taxes and for year-end adjustments.

The combined gross operating income of the group was maintained at a high level during 1950 and may approximate $14,800 million which is 8.2 per cent over the $13,675 million derived in 1949.

Cash dividends declared by the 30 oil companies for disbursement to their stockholders in 1950 may aggregate $683 million, an increase of 21.1 per cent over the $564 million for 1949. This outlay is 41.0 per cent of the estimated available earnings while the balance of 59.0 per cent represents the portion retained in the business.

International Petroleum Consultants Are Formed

A new organization has recently been formed in Pasadena, California, known as International Petroleum Consultants, Ltd., with headquarters in The Petroleum Consultants Building. This new organization brings together recognized leaders in the specialized fields of geology, surface, and subsurface petroleum engineering, petroleum chemistry, geochemistry, and economics.

The principal figure back of the founding of International Petroleum Consultants, Ltd. is Florent Houlding Bailly, long a well-known geologist and petroleum engineer in Venezuela. Bailly, a graduate of California Institute of Technology, was made president of Pantepec Oil Company of Venezuela and its companion company, Pancoastal Oil Company, C. A. of Venezuela in 1949.

Other members of International Petroleum Consultants include: John F. Dodge, petroleum engineer and consultant and past chairman of the division of petroleum engineering at University of Southern California; René Engel, chemical engineer, past curator of minerology and petrology Los Angeles County Museum, California, consulting geologist, geochemist, and engineer; Hans E. Thalmann, petroleum gelogist, stratigrapher, and micropaleontologist; Charles R. Dodson, professor of petroleum engineering at the University of Southern California, and James B. Christie, engineer and patent counsel of Pasadena.

Fiscal Year Incomes Down

Superior Oil Company and Kerr-McGee Oil Industries have reported earnings in the fiscal year ending August 31 and June 30, respectively, slightly lower than those reported for the same period last year. Superior's earnings declined to $6,928,542 from $7,283,542 for the previous year. During the year, Superior participated in the drilling of 170 full-interest and 30 jointly-owned wells, compared with 141 and 57, respectively, in the previous fiscal year. Of the total drilling in the year ended August 31, 157 were producers and 43 were dry. This compared with 130 producers and 68 dry holes in the 1949 year.

Kerr-McGee's net income amounted to $232,452, down from $1,218,637 in the preceeding year. The lower profit, the company stated, was attributed to losses of the refinery department; however, beginning in August, it was stated, the refinery department is again operating at a profit.

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Texas Oil Allowables Are Based on Well Completions

The rapid rate at which new oil wells are being brought into production each month has caused the Texas Railroad Commission to lower that state's allowed oil production. In mid-November the Commission ordered Texas' maximum permitted production for December to be cut 160,000 bbl below the November maximum daily output. This rapid tempo of well completions has been an important factor in the 6 monthly reductions in maximum permitted oil output ordered by the Commission this year. December's allowable is about 500,000 bbl a day above the quota last January 1, but around 300,000 bbl a day of the hike was new oil production.

The search for oil in Texas in 1950 was at its fastest pace ever. A total of more than 9000 oil wells were completed the first 11 months of the year. This resulted in a net addition of 7500 oil wells, increasing the number of oil wells in the state to 124,454 wells at the end of last month. The state had a net gain of 6196 oil wells in 1949.

Oil Reserves Should Be Adequate, Fell Urges

Petroleum reserves adequate to meet all peace-time and emergency needs should be a "basic objective" of the United States. To attain such an objective means the oil industry must discover and make available not only normal needs, but enough in excess to meet any emergency, H. B. Fell, executive vice president of the Independent Petroleum Association of America, told members of the Kansas Independent Oil and Gas Association.

He said the oil industry can accomplish this "only if it has the capital, materials, manpower and freedom from unnecessary government controls." He cited the oil industry's loss of efficiency under government regulations during World War II when productive capacity dropped off 177,000 bbl daily in the 4-year period, 1941-1945.

"Among the reasons for this unsound trend was the freezing of crude oil prices at unrealistic levels, inadequate materials and manpower, and the creeping paralysis that comes with centralized controls," Fell said.

Comparatively, he pointed out, the oil industry has carried out a great expansion in exploration, development, and producing activities in the 5 years since wartime restrictions were lifted.

"Today we have a domestic crude oil producing capacity in excess of 6,000,000 bbl daily, about 1,500,000 bbl a day above the 1945 level," he said. "Each of us must realize that business freedom is threatened as never before," Fell said. "There are some who claim these freedoms, which were regained with considerable difficulty after World War II, are only the selfish concern of individual interests.

"That type of destructive thinking has inspired vicious propaganda against the petroleum industry.

"We must keep in mind that we are not selfish when we oppose these forces for they must be opposed with every resource at our command if we are to maintain the conditions that have been proved to be essential to a vigorous, active, expanding oil producing industry in this country."

Oil Output Hits New High

World crude petroleum production pased 10,000,000 bbl a day for the first time in June 1950, according to a report by the U. S. Department of the Interior, Bureau of Mines. Daily average production of 10,430,000 bbl represented an increase of 620,000 bbl daily over the May production rate. Venezuela set a new monthly record with a gain of 319,000 bbl daily, making a total of 1,572,333 bbl per day in June. Kuwait and Iran increased their daily production rate by 33,000 bbl producing 1,039,966 bbl per day. Saudi Arabia's output was 562,603 bbl per day, a 12,000 bbl daily increase, the report stated.

In the second quarter of 1950 daily average crude production totaled 9,977,000 bbl compared with 9,483,000 bbl in the first quarter, and for the first 6 months of the year it increased 5.4 per cent over the first half of 1949, the Bureau of Mines reported.

Western European crude imports increased 161,000 bbl daily to 853,000 as both France and the Netherlands imported record amounts of crude.

France, Spain May Be Seeking Mexico Crude

Both France and Spain are negotiating with Mexico for crude oil, it is reported. The Compagnie Francaise des Petroles has been negotiating with Mexico off and on for more than a year. E. R. Chevinoff of the French company was in Mexico City recently, reportedly on an oil buying mission. Mexico's domestic consumption takes virtually all her production at present.

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PIPING FABRICATORS AND CONTRACTORS

Personals

C. H. Thompson, company counsel for the American Oil Company since 1926, has been appointed assistant to the vice president in charge of sales. Thompson established the law department of the American Oil Company in 1922. He has also participated in sales promotion and general administrative activities. He is a graduate of the University of Maryland Law School.

C. R. Miller, General Tire and Rubber Company, Baytown, Texas, has been appointed chairman of the instrument mechanics maintenance clinic committee, for the Houston Instrument Society of America's 1951 convention committee. Miller will serve as liason man with the ISA national committee, which handles this function, and will also head all the local work in connection with the clinic. ISA wil sponsor the mechanical maintenance clinic at its sixth annual conference and exhibit in Houston, Texas, during September.

John W. Pegg

J. W. Pegg and **Q. W. Evans** have been named vice presidents of Shell Development Company. Pegg will be in charge of the New York offices of Shell Development, which is the research affiliate of Shell Oil Company. He was born in Kansas City, Missouri, and received his L.L.B. from the University of Missouri. He joined Shell in 1937 as an attorney.

Evans joined the staff as research chemist in 1930, after receiving the Ph.D. degree from the University of Washington. In 1934 he went to Shell Chemical's alcohol plant at Martinez and was assistant superintendent during the plant's initial operations.

M. A. (Woody) Wilson of Bartlesville, Oklahoma, has been elected comptroller of Cities Service Oil Company (Delaware), Cities Service Pipe Line Company and other Bartlesville-affiliated companies, effective January 1. He will also continue as assistant secretary of these companies.

Wilson was reared in the Texas Panhandle, where he received his high school and business education. He was employed by City Light and Water Company, a Cities Service subsidiary, at Amarillo, Texas, from January 1913 to December 1916, at which time he was transferred to Bartlesville.

From 1916 to date, he has served as bookkeeper, auditor, assistant general auditor, general auditor, and assistant secretary of Cities Service Oil Company and the Bartlesville-affiliated companies.

John W. B. Foringer has become associated with Lion Oil Company as director of industrial relations. In his new capacity he will be in charge of all matters relating to personnel and labor relations, and will serve as director and administrator for Lion in union negotiations. Foringer is a graduate of the University of Indiana Law School.

Pedro Emilio Herrera was recently appointed minister of Venezuelan development, and will deal most directly with Venezuela's oil industry. He succeeds **Manuel R. Egana,** and was formerly associated with the public-works department of La Guaira, Caracas' port.

Merrill D. Tate has been elected secretary-treasurer of Republic Natural Gas Company, Dallas, Texas. A certified public accountant, Tate has been senior accountant with the auditing firm of Lybrand, Ross Bros., and Montgomery for the last 6 years. He was earlier associated with Gulf Oil Corporation.

Albert LeRoy Ellsworth, one of Canada's leading industrialists, died recently at his home in Forest Hill Village after a long illness. He was 74. Ellsworth was chairman of the board of directors of The British American Oil Company Limited, which he founded in 1906 and developed into Canada's largest independent oil company. Among the directorships he held were those in the Bank of Nova Scotia, Chartered Trust Company, and Noranda Mines. He founded the British-American Oil Producing Company in 1925 with the first production in the Wichita Falls, Texas area. Later, more extensive oil fields were developed at Bristow, Oklahoma, and the prolific East Texas pools.

Roy J. Diwoky, executive vice president, Pan-Am Southern Corporation, will take over the duties of president during the absence of **Bruce K. Brown,** president, who has been named Deputy Administrator of the Petroleum Administration for Defense in Washington, D. C. Brown is expected to be in Washington for at least a year, serving under Secretary of the Interior Oscar L. Chapman. In November 1941 he was called to Washington as a special consultant and shortly afterwards was appointed assistant deputy administrator of the Petroleum Administration for War. He worked on the program that resulted in the petroleum industry's construction of 189 aviation gasoline refining units in the United States.

After the war Brown returned to civilian life and in 1947 was elected president of Pan-Am Southern Corporation. Since 1947 he had also served as chairman of the Military Petroleum Advisory Board in Washington.

Diwoky, formerly of Standard Oil Company (Indiana), was appointed executive assistant to Brown in June 1949 and was recently made executive vice president. He became associated with Standard Oil Company (Indiana) in 1935, and after five years of service in the research department he was transferred to the manufacturing department in 1940 where he rose to the position of assistant general superintendent of the Whiting, Indiana, refinery.

L. E. Bennett has been named general auditor of Standard Oil of California, succeeding A. H. Kent, who retired after 33 years of service. Bennett, who joined Standard at Los Angeles in 1920, has been assistant general auditor since May, 1944. He held various positions in the marketing department of the company, serving in several of the principal cities on the Pacific Coast. Kent joined Standard at Seattle in May, 1917, as a clerk.

G. W. Dunkley, has been appointed an executive director of the Iraq Petroleum Company and associated companies. Educated at St. Albans School and at Pembroke College, Cambridge, Dunkley entered the London office of the Anglo-Persian Oil Company in 1914. Serving in the first world war, he rejoined Anglo-Persian Oil Company in 1919 and after 4 years with their agents in India, followed by 8 years' service in Persia he became Iraq Petroleum Company's agent in Iraq, Palestine, Transjordan, Syria, and the Lebanon in 1931. In March, 1935, he was appointed general manager in the Middle East.

▸ **J. Calvin Brown,** engineer and patent attorney of Los Angeles, has been elected president of The American Society of Mechanical Engineers for 1951, it was announced at the Society's 71st annual meeting in New York City. He took office at the conclusion of the meeting, together with four regional vice presidents and two directors-at-large who were also elected. The new president will succeed **James D. Cunnigham,** of Chicago, Illinois. A mechanical engineer and attorney at law specializing in patent, trademark, and copyright litigation, Brown became a member of the ASME in 1928.

Regional vice presidents elected are: **Henry Reginald Kessler,** manager, Republic Flow Meters Company, New York; **Stephen Dewey Moxley,** vice president, American Cast Iron Pipe Company, Birmingham, Alabama; **John T. Rettaliata,** dean of engineering, Illinois Institute of Technology, Chicago; **Carl J. Eckhardt** (re-election), professor of mechanical engineering and superintendent of utilities, University of Texas, Austin. Elected as directors-at-large: **Lionel J. Cucullu,** assistant to chief engineer, New Orleans Public Service, Inc., New Orleans, Louisiana, and **Harold E. Martin,** district manager, The Babcock and Wilcox Company, New York.

▸ **Louis W. Storms, Jr.** has been named president of Pantepec Oil Company, C. A., and will have his headquarters at Caracas, Venezuela. He succeeds **F. H. Bailey,** who has resigned to devote more time to the management of International Petroleum Consultants, Ltd., Pasadena, California, of which he is president. He will continue with Pantepec in a consulting capacity.

▸ **Dr. G. G. Oberfell,** retired vice president of Phillips Petroleum Company, has been appointed consultant to Reconstruction Finance Corporation on matters pertaining to the Government's synthetic-rubber program. While at Phillips, Oberfell organized and headed the company's research department.

▸ **Henry Harold Wheatley,** who has held a high position in the management of the Iraq Petroleum Company, died in England on December 10. In 1920 he was named minister of communications and works in Iraq. Retiring from the government service in 1937, Wheatley joined Iraq Petroleum and in January 1938 became deputy to the then managing director, J. Skliros. He had returned from a month's visit to Iraq and Syria only 36 hours before his death.

▸ **F. A. Sackett,** assistant manager at Mankato, Minnesota for Standard Oil Company (Indiana), has retired after 33 years service. **A. K. Reed,** sales manager in the general office at Chicago, will be promoted to succeed him.

Sackett joined Standard in 1917 as a salesman at Mankato, where he was formerly superintendent of schools. After progressing to district superintendent, he was transferred as lubricating correspondent to Des Moines, Iowa, in 1922. Reed joined the company in 1933 as a service station helper at St. Louis, Missouri, where he had advanced to sales manager when transferred to the same position in the general office at Chicago in 1948.

▸ **Dr. George M. Saunders** has been appointed medical director of Socony-Vacuum Oil Company, Inc., succeeding **Dr. Arthur E. Hoag,** who has retired. Dr. Saunders has been medical director of the company's overseas operations for the past year. Before joining Socony-Vacuum he had been associate professor of preventive medicine and associate clinical professor of medicine at Washington University, St. Louis, Missouri.

▸ **Elmore R. Torn** has resigned as state director of the Christian Rural Overseas Program (CROP) in Texas, it was announced by Daniel Russell of College Station, chairman of the Texas CROP Committee. Torn has accepted a position with the Transcontinental Gas Pipe Line Corporation in Houston.

At the same time it was announced that **J. A. Dennis** of Austin, assistant director, had been named acting state CROP director and will direct the overseas relief commodity collection campaign now in progress. During World War II Torn was first an assistant regional director of civilian defense and also served three years overseas in the Army.

▸ **D. E. Burroughs,** general credit manager of the Shell Oil Company, has been elected president of the American Petroleum Credit Association. He succeeds **A. E. Fletcher,** general credit manager of the Standard Oil Company of Ohio. Burroughs, a native of Ouray, Colorado, joined Shell in 1920 as a stock clerk in the company's Portland, Oregon, office. He remained on the Pacific Coast, serving in various positions until 1941 when he was promoted to the post of assistant general credit manager in Shell's head office, New York. He assumed his present position in 1946.

▸ **Sam H. Casey** was promoted to assistant to **R. J. Diwoky,** executive vice president of Pan-Am Southern Corporation, and will move from Shreveport to the New Orleans office. Casey joined Root Petroleum Company in 1948 as manager of crude oil purchasing department, and the company later merged into Pan-Am Southern Corporation. Prior to his service with the Root Petroleum Company, he was with the Sohio Petroleum Company.

John E. Brewster was promoted to assistant manager of crude oil purchasing department of the Pan-Am Southern Corporation, and will assume the duties formerly handled by Casey. Brewer was graduated from the Arkansas A. and M. College at Monticello, Arkansas. After serving 32 months in the Army Air Force in the China-Burma-India area, he began work with the Root Petroleum Company in the pipe line department at El Dorado, later being promoted to engineer in the pipe line and producing operations. In January 1950 he was transferred to Shreveport as assistant to Casey.

▸ **Frank A. Watts,** sales manager for Humble Oil and Refining Company has been named director of the materials division of the Petroleum Administration for Defense. Announcement of the appointment was made by Bruce K. Brown, Deputy Administrator. Watts served in a similar capacity for the PAW from December 1942 through April 1944. He is a veteran oil man with more than 30 years of service with the Humble Company. Prior to becoming sales manager for the company in 1945, he served in the civil engineering department.

▸ **Don Emery,** a member of the board of directors, member of the executive committee and vice president and general counsel of Phillips Petroleum Company, has resigned to enter the private practice of law in Oklahoma City, Oklahoma. He will continue to serve as a member of the board of directors of Phillips Petroleum and as a member of the board of directors of American Independent Oil Company. Emery has been an employee of the company for over a quarter of a century and a director and officer since January 1, 1938.

Rayburn L. Foster, assistant general counsel, was elected vice president and general counsel of Phillips Petroleum Company to fill the vacancy occurring by reason of Emery's resignation. Foster has over 22 years continuous service with the company.

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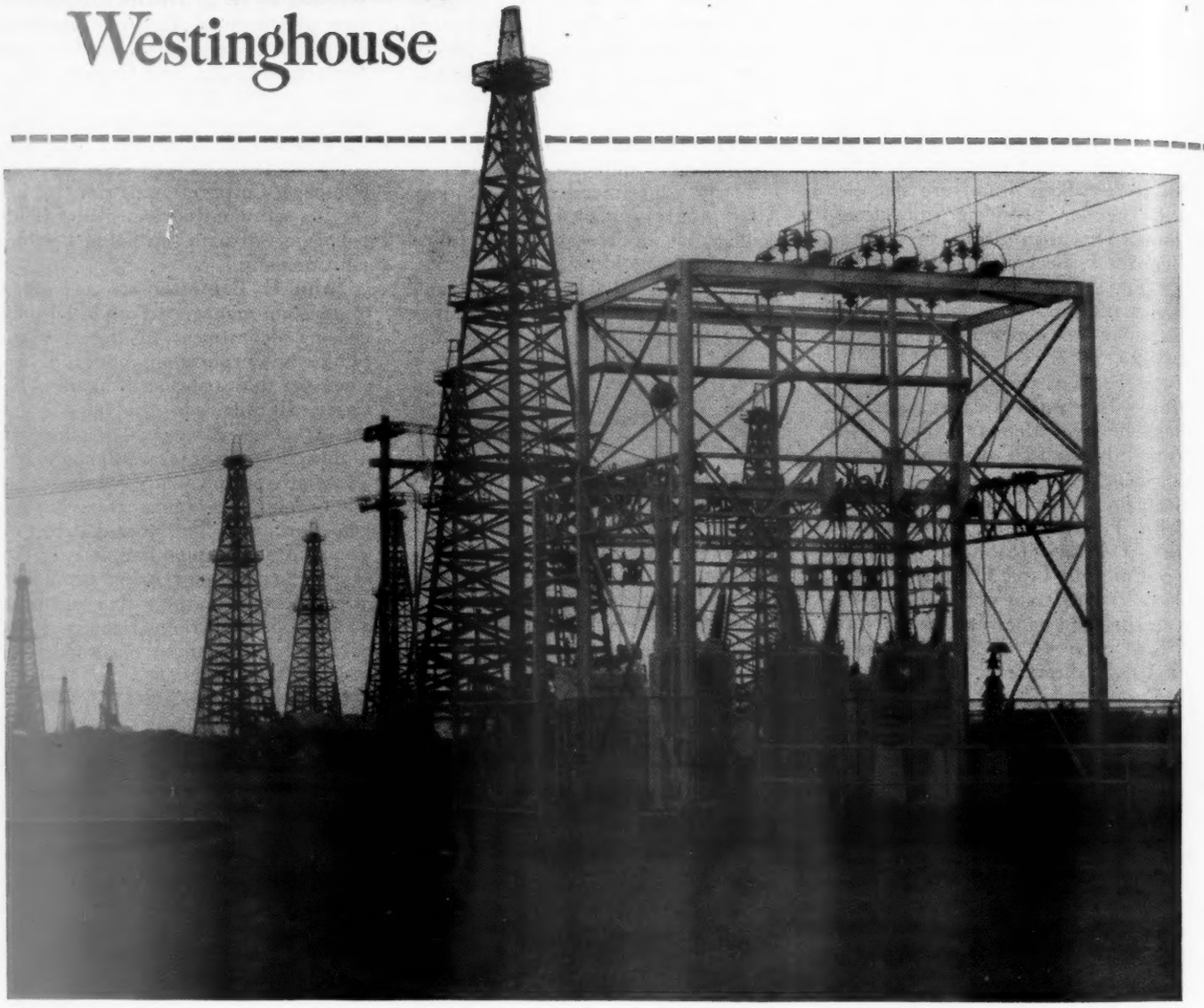

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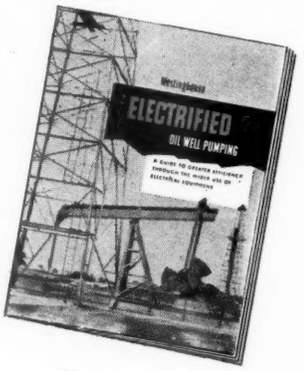

BIBLIOGRAPHY—Classified list of important papers for 1949 - 1950

Classification by Authors
Continued

T

Tanner, E. M. (Bryant, K. C. and Kennedy, G. T.), Alkylnaphthalenes, J. Inst. Petr. 35, 508-14, July, 1949.

Tanner, N. E., Some International Aspects of Canadian Oil and Gas Development, API, 29th Annual Meeting, Stevens Hotel and Palmer House, Chicago, Ill., Nov. 7-10, 1949.

Taylor, C. F. (Leary, W. A., Livengood, J. C., Russell, W. A., and Taylor, E. S.), The Ignition of Fuels by Rapid Compression, SAE, Annual Meeting, Book-Cadillac Hotel, Detroit, Mich., Jan. 9-13, 1950.

Taylor, C. Fayette, Correlation and Presentation of Diesel Engine Performance Data, SAE, National West Coast Meeting, Biltmore Hotel, Los Angeles, Calif., Aug. 14-16, 1950.

Taylor, E. S. (Leary, W. A. Livengood, J. C., Russell, W. A., and Taylor, C. F.), The Ignition of Fuels by Rapid Compression, SAE Annual Meeting, Book-Cadillac Hotel, Detroit, Mich., Jan. 9-13, 1950.

Taylor, J. E. (Offutt, W. C. and Swartz, G. B., Jr.), Fuels for High Compression Engines. A Preliminary Study of the Selective Blending of Gasoline Distillates from Present-Day Refining Processes, Ind. Eng. Chem. 41, 2359-65, Oct., 1949.

Taylor, R. C. (Dunn, E. B., Melpolder, F. W., and Young, W. S.), Description and Application of a Dual Automatic Potentiometric Titrimeter, API, Mid-Year Meeting, Division of Refining, Hotel Cleveland, Ohio, May 1-4, 1950.

Taylor, T. I. (Doering, W. V. E. and Nash, L. M.), Isomerization of n-Propyl Chloride, J. Am. Chem. Soc. 71, 1516-17, April, 1949.

Taylor, W. J. (Holden, R. B. and Johnston, H. L.), Infrared Spectra of Liquid and Solid Methane, J. Chem. Phys. 17, 1356, Dec., 1949.

Tellington, W. J., Progress Report on Devonian Reef Exploration in Canada, AAPG, Annual Meeting, Stevens Hotel, Chicago, Ill., April 24-27, 1950.

Terrill, Dean, Unitization, Its Past and Future, Oil and Gas Law Institute, Rainbow Hotel, Great Falls, Mont., June 24-25, 1949.

Terry, J. M. (Downing, R. B.), Introduction to Radioactivity Well Logging, API, Spring Meeting, Eastern District, Division of Production, Hotel Cleveland, Cleveland, Ohio, April 26-28, 1950.

Test, L. J. (Hall, C. A.), Piston Oil-Ring Plugging, SAE Jrnl. 58, 28-33, Feb., 1950.

Tewksbury, C. I. (Haendler, H. M.), Metal Fluorides as Fluorinating Agents, J. Am. Chem. Soc. 71, 2336-7, July, 1949.

Thomas, B. W. (Seyfried, W. D.), Mass Spectrometer Analyses of Oxygenated Compounds, Anal. Chem. 21, 1022-6, Sept., 1949.

Thomas, C. L. (Hickey, John and Stecker, Glen), Chemistry of Clay Cracking Catalysts, Ind. Eng. Chem. 42, 866-71, May, 1950.

Thomas, Charles L., Chemistry of Cracking Catalysts, Ind. Eng. Chem. 41, 2564-73, Nov., 1949.

Thomas, J. B., Case History of Federal Encroachment Upon the Electric Industry, API, 29th Annual Meeting, Stevens Hotel and Palmer House, Chicago, Ill., Nov. 7-10, 1949.

Thomas, P. R. (Donn, L. and Levin, H.), Carbon Monoxide in Olefinic Gases, ACS, 115th Meeting, Division of Petroleum Chemistry, San Francisco, Calif., March 27-April 1, 1949.

Thomas, R. W. (Oberfell, G. G.), Petroleum Production Reverses Its Field, Chem. Eng. News 28, 21-2, Jan. 2, 1950.

Thomas, W. E., Magnetic-Particle Inspection in the Petroleum Industry, API, Spring Meeting, Eastern District, Division of Production, Hotel Cleveland, Cleveland, Ohio, April 26-28, 1950.

Thompson, C. F. (Ball, John S., Dinneen, G. U., and Smith, J. R.), Adsorption Analysis by Displacement Techniques, ACS, 116th Meeting, Division of Petroleum Chemistry, Symposium on Adsorption, Atlantic City, N. J., Sept. 18-23, 1949.

Thompson, C. N. (Beaven, G. H. and Foster, L. F.), Determination of Saturated and Aromatic Constituents in Spindle Distillates and Derived Products by Adsorption Fractionation, J. Inst. Petr. 36, 89-104, Feb., 1950.

Thompson, Ernest O., The 1949 Look in Oil, Texas Mid-Continent Oil and Gas Association, 30th Annual Meeting, Houston, Tex., Oct. 13-14, 1949.

Thompson, H. W. (Miller, C. H.), Ultraviolet Absorption of Fluorinated Aromatic Hydrocarbons, J. Chem. Phys. 17, 845-6, Sept., 1949.

Thompson, Howard (Hall, H. N. and Nuss, Frank), Ability of Drilling Muds to Lift Bit Cuttings, AIME, Petr. Branch Fall Meeting, Plaza Hotel, San Antonio, Tex., Oct. 5-7, 1949.

Thompson, R. B. (Chenicek, J. A. and Druge, L. W.), Effect of Sulfur Compounds in Fuel Oils on Storage Stability, Ind. Eng. Chem. 41, 2715-21, Dec., 1949.

Thomson, George W., Nomographs for Paraffins and Naphthenes, Anal. Chem. 21, 644-5, May, 1949.

Thornton, D. P., Jr., New Montana Refinery, Petroleum Processing 5, 256-60, March, 1950.

Thornton, V. (Condon, F. E. and McMurry, H. L.), Infrared Spectra of Propane and Deuteropropanes, J. Chem. Physics 17, 918-22, Oct., 1949.

Tice, E. A. (Pogacar, C. F.), Corrosion Problems in The Modern By-Product Coke Plant, NACE, 1950 Conference and Exhibition, Hotel Jefferson, St. Louis, Mo., April 4-7, 1950.

Tierney, W. T. (Barber, E. M. and Reynolds, Blake), The Elimination of Combustion Knock—Texaco Combustion Process, SAE, Summer Meeting, French Lick Springs Hotel, French Lick, Ind., June 4-9, 1950.

Tiller, F. M., Gas Absorption, Extraction, and Washing, Chem. Eng. Progress 45, 391-401, June, 1949.

Tilton, V. V. (Hess, L. G.), Ethylene Oxide, Hazards and Methods of Handling, Ind. Eng. Chem. 42, 1251-8, June, 1950.

Tobolsky, A. V. (Mesrobian, R. B. and Metz, D. J.), Low Temperature Autoxidation of Hydrocarbons: The Phenomenon of Maximum Rates, J. Am. Chem. Soc. 72, 1942-52, May, 1950.

Todd, Robert (Stiles, W. E.), Diamond Bit Coring, AIME, Annual Joint Meeting of the Texas Sections, A & M College of Texas, College Station, Tex., Dec. 8-9, 1949.

Tomlinson, C. W. Freedom and Petroleum Geology, AAPG, Annual Meeting, Stevens Hotel, Chicago, Ill., April 24-27, 1950.

Tomlinson, C. W., Lost Reserves, AIME, Petroleum Branch Fall Meeting, Plaza Hotel, San Antonio, Tex., Oct. 5-7, 1949.

Tongberg, C. O. (Boehn, A. B.), High Detergency Motor Oils, ASTM, First Pacific Area National Meeting, Fairmont and Mark Hopkins Hotels, San Francisco, Calif., Oct. 10-14, 1949.

Toomey, E. G. State Oil and Gas Leases, Oil and Gas Law Institute, Rainbow Hotel, Great Falls, Mont., June 24-25, 1949.

Torrey, Paul D., General Factors and Consideration of Secondary Recovery Operations in the Petroleum Ind., Colorado School of Mines, 75th Anniversary, Golden, Colorado, Sept. 29-Oct. 1 1949.

Torrey, Paul D., Economic Significance of Secondary Recovery in the Eastern States, IOCC, 1950 Summer Meeting, French Lick Springs Hotel, French Lick, Ind., Aug. 3-5, 1950

Torrey, Paul D., The Possibilities of Secondary Recovery By Mining in the United States, IOCC, Summer Quarterly Meeting, Estes Park, Colorado, Sept. 1-3, 1949.

Treseder, R. S. (Wachter, A.), Corrosion in Processes Employing Aluminum Chloride, Corrosion 5, 383-91, Nov., 1949.

Trotman-Dickenson, A. F. (Steacie, E. W. R.), The Reactions of Methyl Radicals With Hydrocarbons, J. Am. Chem. Soc. 72, 2310-11, May, 1950.

Trouard, Sidney E., Report of Corrosion Committee, AGA, 31st Annual Convention, Palmer House, Chicago, Ill., Oct. 17-20, 1949.

Trube, A. S., Jr. (DeWitt, Sam N.), Primary Pressure Maintenance With Water Injection in the New Hope Field, Franklin County, Texas, AIME, Petroleum Branch Fall Meeting, Plaza Hotel, San Antonio, Tex., Oct. 5-7, 1949.

Turk, Lon B., Significance and Use of Layout Maps in Prospecting for Oil and Gas, AAPG, Mid-Continent Regional Meeting, Skirvin Hotel, Oklahoma City, Okla. Jan. 12-13, 1950.

Turner, E. E. (Shine, H. J.), Synthesis of 2, 3, 5-Trimethylhexane and of 2, 4, 6-Trimethylheptane, J. Inst. Petr. 36, 70-3, Feb., 1950.

Turner, Lloyd L., Realism in Air Preparedness, NGAA, 29th Annual Convention, Texas Hotel, Fort Worth, Tex., April 24-26, 1950.

Tuttle, R. B., Crude-Oil Capacity Stepped Up 50 Per Cent, Oil and Gas J. 48, 105-6, Feb. 16, 1950.

Tuttle, R. B. (Casper, J. C. and McCaslin, L. S., Jr.), Growth Pattern of Gulf Coast Oil Industry, Oil and Gas J. 49, 166-70, June 22, 1950.

U

Ubbelohde, A. R. (Small, N. J. H.), Crossed Reaction Chains in Oxidation by Molecular Oxygen. Part I. Oxidation of Hydrocarbons in Aldehyde-Air Mixtures, J. Chem. Soc., 723-8, Feb., 1950.

Uhl, W. C., Graphic Panels, The New Look in Instrumentation, Petr. Processing 5, 361-8, April, 1950.

Uhl, William C., Rapid Pay-Off in Saving Vapors, Petr. Processing 4, 249-53, March, 1949.

Uhlig, H. H. (Noss, Oscar F., Jr.), Potentials Set Up By Thermal Gradients in Iron Immersed in NaCl Solutions, NACE, 1950 Conference and Exhibition, Hotel Jefferson, St. Louis, Mo., April 4-7, 1950.

Uhrig, K. (Becker, H. C., Levin, H., and Milberger, E. C.), Determination of Water in Hydrogen Chloride, Anal. Chem. 21, 1192-4, Oct., 1949.

Uitti, K. D., Control Point Location and Fractionator Column Operation, Petr. Processing 5, 41-4, Jan., 1950.

Ulmer, R. C., Modern Trends in Industrial Water Treating, WPRA, 38th Annual Meeting, San Antonio, Tex., March 27-29, 1950.

Ulzheimer, C. J. (Nelson, F. L.), Ethyl Ether Best for Starting Cold Diesels, SAE Journal 58, 42-5, March, 1950.

Ungnade, H. E. (Crandall, E. W.), The Reaction of Aryl Carbinols With Aluminum Chloride and Aromatic Hydrocarbons, J. Am. Chem. Soc. 71, 3009-10, Sept., 1949.

Unruh, C. H. (Katz, D. L.), Gas Hydrates, J. Petroleum Technology 1, 83-5, April, 1949.

Urry, W. H. (Kharasch, M. S. and Kuderna, B. M.), Addition of Aldehydes to Olefins, J. Org. Chem. 14, 248-53, March, 1949.

Uwatoko, K. (Stach, Leo W.), Geological Control of Methane Gas Accumulation in Japan, AAPG, Annual Meeting, Stevens Hotel, Chicago, Ill., April 24-27, 1950.

Uytenbogaart, J. W. H., Some Aspects of the Development of the Petroleum Chemical Industry in The Netherlands, UNSCCUR, Lake Success, N. Y., Aug. 17-Sept. 6, 1949.

V

Vahrman, M., Hot Chromatography of Whole Tar, Nature 165, 404-5, March 11, 1950.

Vandaveer, F. E., Chemistry in the Gas Industry, AGA, 31st Annual Convention, Palmer House, Chicago, Ill., Oct. 17-20, 1949.

Vander Werth, A., Soap from Hydrocarbons, Soap and Sanitary Chemicals 25, 63, July, 1949.

Verdun, Leonard (Dobyns, Rollie P.), Water-Flood Survey—North Texas, North Texas Oil and Gas Association, 20th Annual Meeting, Kemp Hotel, Wichita Falls, Tex., March 25, 1950.

Vesely, J. A. (Kvetinskas, Bruno and Pines, Herman), Reaction of Thiophene With Olefinic Compounds, J. Am. Chem. Soc. 72, 1568-71, April ,1950.

Vickery, B. C. (Denbigh, K. G.), Bond Refractions in the Alkanes, Trans. Faraday Soc. 45, 61-81, Jan., 1949.

Vincent, R. R. (Huffman, K. P.), Resume of Water Flood Operations in Illinois, Indiana, Kentucky, Michigan, Ohio, and West Virginia, API, Spring Meeting, Eastern District, Division of Production, Hotel Cleveland, Cleveland, Ohio, April 26-28, 1950.

Visser, G. H., Some Research on Aromatization Catalysts Based on the Oxides of Chromium and Aluminum, Bull assoc. franc. techniciens petrole, No. 80, 3-15, April 1, 1950.

Vitter, A. L., Jr., Offshore Operations, IOCC, Winter Annual Meeting, New Orleans, La., Dec. 5-7, 1949.

Voge, H. H. (Good, G. M. and Greensfelder, B. S.), Cracking of Pure Hydrocarbons, Ind. Eng. Chem. 41, 2573-84, Nov., 1949.

Voigt, M. J. (Hardie, B. G.), Use of Periodicals in Petr. Research, Oil and Gas J. 49, 121, 159-61, May 18, 1950.

Vollmer, W. G., Trends in Americanism, IPAA, 20th Anniversary Meeting, Ft. Worth, Tex., Oct. 3-4, 1949.

Voorhies, H. J., Supervisory Development Program at Esso Standard's Baton Rouge Refinery, API, Mid-Year Meeting, Division of Refining, Hotel Cleveland, Cleveland, Ohio, May 1-4, 1950.

W

Waber, J. T., Generalized Theory of Stress Corrosion, National Metal Congress and Exposition, 31st Meeting, Public Auditorium, Cleveland, Ohio, Oct. 17-21, 1949.

Wachter, A. (Treseder, R. S.), Corrosion in Processes Employing Aluminum Chloride, Corrosion 5, 383-91, Nov., 1949.

Waddington, Guy (Huffman, H. M., Scott, D. W., and Smith, J. C.), Heat Capacities of 3 Hexanes, J. Am. Chem. Soc. 71, 3902-6, Dec., 1949.

Wade, O. W., Surface Potential Method on Corrosion Survey of Pipe Lines, NACE, 1950 Conference and Exhibition, Hotel Jefferson, St. Louis, Mo., April 4-7, 1950.

Waele, A. de, Petroleum Jelly, Nature 163, 774, May 14, 1949.

Wagner, C. D. (Beeck, O., Otvos, J. W., and Stevenson, D. P.), Hydrogen Exchange Reactions of Paraffins on Isomerization Catalyst, J. Chem. Phys. 17, 419-20, April, 1949.

Wahlquist, Hugo W., Cathodic Protection to Bare Pipe Lines, AGA, Distribution Motor Vehicles and Corrosion Conference, Hotel Book-Cadillac, Detroit, Mich., April 3-5, 1950.

Waight, E. S. (Braude, E. A.), N-Bromosuccinimide as a Reagent for Bromine Addition, Nature 164, 241, Aug. 6, 1949.

Walker, C. A., Separation of m- and p-Cresols by Liquid-Liquid Extraction, Ind. Eng. Chem. 42, 1226-9, June, 1950.

Walker, R. G., Brazilian Oil Consumption Doubles in Six Years, World Petr. 21, 40-2, June, 1950.

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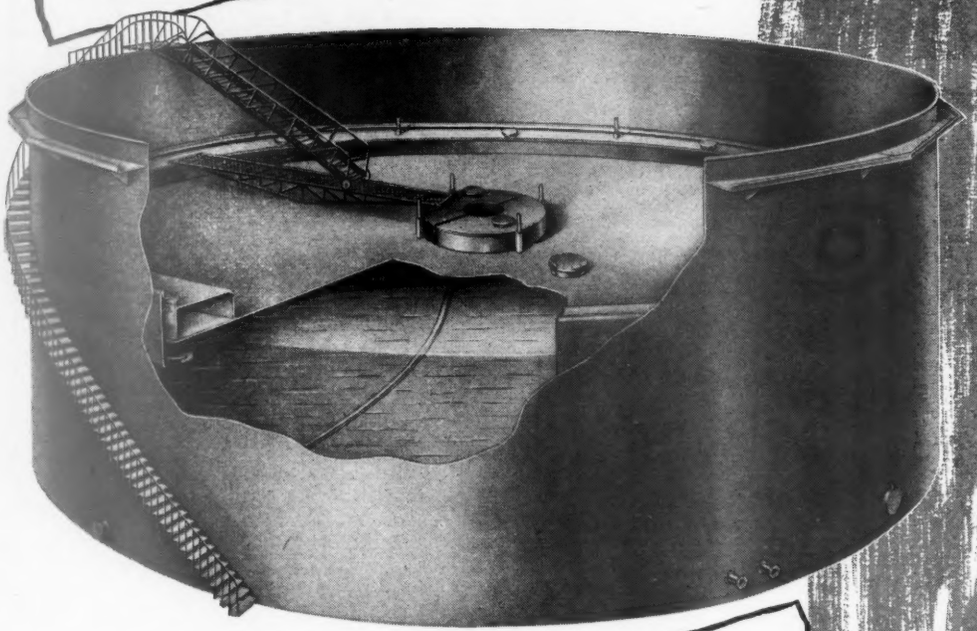

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BIBLIOGRAPHY—Classified list of important papers for 1949 - 1950

Wallace, W. A. (Durand, E. J. and King, R. O.), The Oxidation, Ignition, and Detonation of Fuel Vapors and Gases. IX. The Cause of the Reversal of the Anti-knock Property of Rich Hydrocarbon Air Mixtures, Can. J. Research (F) 27, 307-10, Aug., 1949.

Wallin, G. R., Basic Fuchsin for Determining a Surface-Active Agent, Anal. Chem. 22, 616-7, April, 1950.

Walling, Cheves, The Acid Strength of Surfaces, J. Am. Chem. Soc. 72, 1164-8, March, 1950.

Wallis, R. F. (Dickinson, R. G. and Wood, R. E.), Iodine-Sensitized Cis-Trans Isomerization of Dichloroethylene, J. Am. Chem. Soc. 71, 1238-54, April, 1949.

Walls, Fred J., Brake Drum Materials, SAE, Annual Meeting, Book-Cadillac Hotel, Detroit, Mich., Jan. 9-13, 1950.

Walsh, A. (Willis, J. B.), Infrared Absorption Spectra at Low Temperatures, J. Chem. Phys. 17, 838, Sept., 1949.

Walsh. A. D.. Antiknock Effect of Aromatic Compounds, Trans. Faraday Soc. 55, 1043-8, Nov., 1949.

Walsh, A. D. (Chamberlain, G. H. N.), Oxidation of Fuels, Trans. Faraday Soc. 55, 1032-43, Nov., 1949.

Walsh, T. A., Eye Protection Standards for Drilling Industry, AAODC, 5th Annual Drilling Safety Clinic, Crystal Ballroom, Baker Hotel, Dallas, Tex., June 15-16, 1950.

Walsh, T. J. (Desai, A. M. and Prutton, C. F.), Solvent Extraction of Tar Acids from Coal Tar Hydrocarbons, Ind. Eng. Chem. 42, 1210-17, June, 1950.

Walters, E. L. (Larsen, R. G.), Evaluation of Petroleum-Base Rust Preventives, NACE. 5th Annual Convention, Cincinnati, Ohio, April 11-14, 1949.

Walters, Robert F., Oil Production from Pre-Cambrian Basement Rocks in Central Kansas, AAPG, Mid-Continent Regional Meeting. Skirvin Hotel, Oklahoma City, Okla., Jan. 12-13, 1950.

Walton, J. S. (McCullough, J. P.), Catalytic Dehydrogenation of Ethane by Selective Oxidation, Ind. Eng. Chem. 41, 1455-9, July, 1949.

Ward, C. C. (Schwartz, F. G.), Pilot-Size Continuous Still, Petr. Processing 5, 164-6, Feb., 1950.

Ward, S. H. (Clark, K. A.), Determination of the Viscosities and Specific Gravities of the Oils in Samples of Athabaska Bituminous Sand, Research Council of Alberta, Report No. 57, March, 1950.

Warren, J. Ed, The Independent Operator in 1950, IPAA, Mid-Year Meeting of the Directors, Biltmore Hotel, Los Angeles, Calif., May 8-9, 1950.

Warren, J. Ed, Object—A Healthy Domestic Oil Industry, North Texas Oil and Gas Ass'n., 20th Annual Meeting, Kemp Hotel, Wichita Falls, Tex., March 25, 1950.

Waterman, H. I. (LaLau, C. and Lecomte, J.), Infrared Spectrometry and the Analysis of Hydrocarbons, Bull. Soc. Chim. France Nos. 1-2, 141-6, Jan.-Feb., 1950.

Waters, W. A. (Derbyshire, D. H.), An Oxidation Involving the Hydroxyl Cation (OH)+, Nature 165, 401, March 11, 1950.

Waters, W. A. (Cosgrove, S. L.), Oxidation of Phenols with Benzoyl Peroxide, J. Chem. Soc., 3189-94, Dec., 1949.

Waters, W. A. (Mers, J. H.), Oxidation of Aromatic Compounds, J. Chem. Soc., 2427-33, Oct., 1949.

Weaver, B. R.. Acidization in the Permian Basin, AIME, Annual Joint Meeting of the Texas Sections, A & M College of Texas, College Station, Tex., Dec. 8-9, 1949.

Weaver, J. R. (Brattain, R. Robert), A Common-Matrix System of Spectrochemical Analysis, Anal. Chem. 21, 1038-41, Sept., 1949.

Weaver, Paul, Possible Future Oil Provinces of North America—Continental Shelf in Gulf of Mexico, AAPG, Annual Meeting, Stevens Hotel, Chicago, Ill., April 24-27, 1950.

Weber, George, 85 Per Cent of Nation's Capacity for Petrochemicals Concentrated Along Gulf Coast, Oil and Gas J. 49, 171-3, 305-6, June 22, 1950.

Weber, George, Balls of Fuel, Oil and Gas J. 49, 94, May 25, 1950.

Weber, George, Refiners Object, Oil and Gas J. 48, 68, April 27, 1950.

Weber, George, Climbing Octanes, Oil and Gas J. 48, 63, April 27, 1950.

Weber, George, Transmission Fluids, Oil and Gas J. 48, 51-2, March 9, 1950.

Weber, George, Platforming Report, Oil and Gas J. 48, 22-3, March 2, 1950.

Weber, George, Sulfur-Recovery Plant, Oil and Gas J. 48, 38, Dec. 29, 1949.

Weber, George, Venezuelan Refinery Construction, Oil and Gas J. 48, 156-7, 273, Dec. 22, 1949.

Weber, George, Radioisotopes and Oil, Oil and Gas J. 48, 42, Dec., 1949.

Weber, L. J. (Buell, Keith), Ethylene Production by Thermocracking of Propane and Ethane Mixtures, Colorado School of Mines, 75th Anniversary, Golden, Colo., Sept. 29-Oct. 1, 1949.

Webster, E. M. Radio and the Petroleum Industry, API, 29th Annual Meeting, Stevens Hotel and Palmer House, Chicago, Ill., Nov. 7-10, 1949.

Weintraub, Murray (Grummer, Milton and Leva. Max), Heat Transmission Through Fluidized Beds of Fine Particles, Chem. Eng. Progress 45, 563-72, Sept., 1949.

Weintraub, Murray (Leva, Max), Nomographs for Pressure Drop Through Fixed and Fluidized Beds, Chem. Eng. 57, 110-13, Jan., 1950.

Weisel, C. A. (Fleming, C. L., Jr., Geddes, B. W., and Hakala, N. V.), The Performance of High V. I. Motor Oils, SAE, Annual Meeting, Book-Cadillac Hotel, Detroit, Mich., Jan. 9-13, 1950.

Weissler, Alfred, Physico-Chemical Effects of Ultrasonics, AIChE, Boston Regional Meeting, New Ocean House, Swampscott, Mass., May 28-31, 1950.

Weller, Sol (Friedman, Sam, Pelipetz, M. G., and Storch, H. H.), Coal Hydrogenation Catalysts, Ind. Eng. Chem. 42, 330-4, Feb., 1950.

Weller, Sol (Clark, E. L. and Pelipetz, M. G.), Mechanism of Coal Hydrogenation, ACS, 116th Meeting, Division of Gas and Fuel, Atlantic City, N. J., Sept. 18-23, 1949.

Weller, Sol (Friedel, R. A.), Isomer Distribution in Fischer-Tropsch Hydrocarbons, J. Chem. Phys. 18, 157-8, Jan., 1950.

Weller. Sol (Friedel, R. A.), Isomer Distribution in Hydrocarbons from the Fischer-Tropsch Process, J. Chem. Phys. 17, 801-3, Sept., 1949.

Welling, C. E. (Corson, B. B., Jones, H. E., Hinckley, J. A., and Stahly, E. E.), Butadiene From Ethyl Alcohol, Ind. Eng. Chem. 42, 359-75, Feb., 1950.

Wells, E. J., Jr. (Bloom, E. G., Lengel, J. H., Mohler, F. L., and Wise, C. E.), Doubly Charged Ions in Mass Spectra, J. Research Natl. Bur. Standards 42, 369-78, April, 1949.

Wells, E. J. (Bloom, E. G., Mohler, F. L., Williamson, L., Wise, C. E.), Mass Spectra of C_5H_8 Isomers, J. Research Natl. Bur. Standards 43, 533-6, Dec., 1949.

Wells, E. J. (Bloom, E. G., Dean, H. M., Williamson, Laura, Wise, C. E., and Mohler, F. L.), Mass Spectra of Nonanes, J. Research Natl. Bur. Standards 44, 291-7, March, 1950.

Wells, E. J. (Bloom, E. G., Mohler, F. L., and Wise, C. E.), Metastable Transitions in Mass Spectra of Hydrocarbons. J. Research Natl. Bur. Standards 43, 65-70, July, 1949.

Welsh, A. F., Hydraulic Decoking, Petr. Processing 5, 157-60, Feb., 1950.

Wender, Irving (Friedel, R. A. and Orchin, Milton), Determination of Deuterium in Water, Anal. Chem. 21, 1072-3, Sept., 1949.

Wenner, Wilhelm, Raney Nickel Catalyst, J. Org. Chem. 15, 301-4, March, 1950.

Wertzler, R. (Kinder, J. F.), The Mass Spectrometer—A Tool for the Petroleum Processor, Petr. Processing 4, 515-18, May, 1949.

West, J. P. (Schmerling, Louis), Peroxide in Hydrocarbon-Polychloroethylene Reactions, J. Am. Chem. Soc. 71, 2015-19, June, 1949.

West, James (Denzler, H. E. and Scott, J. W.), Installation of Offshore Pipelines, AIME, Petroleum Branch Fall Meeting, Plaza Hotel, San Antonio, Tex., Oct. 5-7, 1949.

West, P. W. (Hale, C. H.), Application of Polarography in the Petroleum Industry, Petr. Refiner 29, 109-11, June, 1950.

West, Thomas S., A Gravel-Pack Completion for Exclusion of Gas and Water, AIME, Annual Joint Meeting of the Texas Sections, A & M College of Texas, College Station, Tex., Dec. 8-9, 1949.

Weston, R. F., Separation of Oil Refinery Waste Waters, Ind. Eng. Chem. 42, 607-12, April, 1950.

Wheatley, P. J. (Linnett, J. W.), Burning of Ethylene-Air Mixtures, Trans. Faraday Soc. 55, 1152-8, Dec., 1949.

Wheeler, Robert R., Age of Orogenic Movements in the Andarko Basin, AAPG, Mid-Continent Regional Meeting, Skirvin Hotel, Oklahoma City, Okla., Jan. 12-13, 1950.

Wherry, T. C. (Crawford, F. W.), Automatic Infrared Analyzers, Oil and Gas J. 48, 272-3, March 23, 1950.

Whitaker, G. C., Corrosion of Metals in Fluorine and Hydrofluoric Acid, NACE, 1950 Conference and Exhibition, Hotel Jefferson, St. Louis, Mo., April 4-7, 1950.

White, J. U. (Liston, M. D. and Simard, R. G.), Recording Infrared Spectrometer, Anal. Chem. 21, 1156-61, Oct., 1949.

White, R. R. (Resnick, Wm.), Mass Transfer Between Fluidized Solids and Gases, Chem. Eng. Progress 45, 377-90, June, 1949.

White, R. R. (Crooks, R. C.), Rate of Sulfonation of Benzene With Sulfuric Acid, Chem. Eng. Progress 46, 249-57, May, 1950.

White, T. A. (Meadow, J. R.), Desulfurization of Heptane Solutions of Organic Sulfur Compounds, Ind. Eng. Chem. 42, 925-9, May, 1950.

Whitehead, W. L. (Breger, I. A.), The Origin of Petroleum, Science III, 335-7, March 31, 1950.

Whitehouse, A. M. (Clark, E. L. and Kandiner, H. J.), Techniques in High Pressure Vessel Design, ASME, Process Industries Division and Pittsburgh Mechanical Engineering Conference, Hotel William Penn, Pittsburgh, Pa., April 24-27, 1950.

Whiting, R. L. (Lancaster, E. H., Jr.), Drilling Mud and Its Relation to Well Completions, AIME, Annual Joint Meeting of the Texas Sections, A & M College of Texas, College Station, Tex., Dec. 8-9, 1949.

Whitley, Edgar D. (Hudson, Charles, Landua, Oliver H. and Whitson, Ray W.), Research and Some of the Recent Developments in Specifications for Government Purchases of Petroleum Products, NPA, 47th Annual Meeting, Hotel Traymore, Atlantic City, N. J., Sept. 14-16, 1949.

Whitman, Walter G., Liquid-Fuel Supplies and National Security, API, 29th Annual Meeting, Stevens Hotel and Palmer House, Chicago, Ill., Nov. 7-10, 1949.

Whitmore, F. C. (Cook, N. C. and Ecke, G. G.), Some Reactions of t-Butylethylene, J. Am. Chem. Soc. 72, 1511-13, April, 1950.

Whitmore, F. C. (Cook, N. C. and Whitmore, H. E.), Three New Octenes, J. Am. Chem. Soc. 72, 51-3, Jan., 1950.

Whitmore, H. E. (Cook, N. C. and Whitmore, F. C.), Three New Octenes, J. Am. Chem. Soc. 72, 51-3, Jan., 1950.

Whitson, Ray W. (Hudson, Charles, Landua, Oliver H. Whitley, Edgar D.), Research and Some of the Recent Developments in Specifications for Government Purchases of Petroleum Products, NPA, 47th Annual Meeting, Hotel Traymore, Atlantic City, N. J., Sept. 14-16, 1949.

Whorton, L. P. (Kieschnick, W. F., Jr.), A Preliminary Report on Oil Recovery by High-Pressure Gas Injection, API Spring Meeting, Mid-Continent District, Division of Production, Skirvin Hotel, Oklahoma City, Okla., March, 29-31, 1950.

Whytlaw-Gray, R. (Casado, F. L. and Massie, D. S.), The Molecular Weight and Limiting Density of Propane, J. Chem. Soc. 1746-52, July, 1949.

Wiberley, S. E. (Bassett, L. G.), Infrared Absorption Band of n-Butyl Group, Anal. Chem. 22, 841-2, June, 1950.

Wiegel, Willard G., Industry's Training Job, NGAA, 29th Annual Convention, Texas Hotel, Fort Worth, Tex., April 24-26, 1950.

Wier, T. P., Jr. (Clere, R. J. and Kincannon, C. B.), Chromatographic Analysis of Gas Oils for Hydrocarbon Types, ACS, 116th Meeting. Division of Petroleum Chemistry, Symposium on Adsorption, Atlantic City, N. J., Sept. 18-23, 1949.

Wiggins, D. M., The Plight of American Individualism, API, Spring Meeting, Southwestern District, Division of Production, Adolphus Hotel, Dallas, Tex., March 8-10, 1950.

Wiig, E. O. (Juhola, A. J.), Pore Structure in Activated Charcoal, J. Am. Chem. Soc. 71, 2069-77, 2078-80, June, 1949.

Wilcox, G. W. (Gambrill, C. M. and Pecherer, B.), Determination of Bromine and Chlorine in Gasoline, ACS, 116th Meeting. Division of Analytical and Micro Chemistry, Atlantic City, N. J., Sept. 18-23, 1949.

Wilczewski, John W. (Hughes, Harold K.), Rapid X-Ray Determination of Sulfur in Distillate Fuels, API, Mid-Year Meeting, Division of Refining, Hotel Cleveland, Cleveland, Ohio, May 1-4, 1950.

Wilkinson, E. Paul (Stark, B. J.), New Data on Use of Solid Dessicants, AGA, Natural Gas Spring Meeting, Hotel Mayo, Tulsa, Okla., May 8-9, 1950.

Wilkinson, P. G (Johnston, H. L.), Absorption Spectra of Gases, J. Chem. Phys. 18, 190-3. Feb., 1950.

Willcox, O. W., Protein From Petroleum, World Petr. 21, 68, April, 1950.

Williams, C. R. (Johnson, C. B., Jr. and Johnson, V. P.), Underground Storage of Liquefied Petroleum Gases, NGAA. 29th Annual Convention, Texas Hotel, Fort Worth, Tex., April 24-26, 1950.

Williams, F. A. (Cox. H. Roxbee), Future Trends in Fuel Utilisation, UNSCCUR, Lake Success, New York, N. Y., Aug. 17-Sept. 6, 1949.

Williams, F. C. (Bennett, R. B. and Seyer, W. F.), Density and Transition Points of Solid Hexamethylene, J. Am. Chem. Soc. 71, 3447-51, Oct., 1949.

Williams, G. C. (Nichols, J. H. and Stigger, E. K.), Plate Efficiencies in Fractionating Columns, Chem. Eng. Prog. 46, 7-16, Jan., 1950.

Williams, Milton (Buchan, R. C., Spain. H. H., and Sullivan, R. J.), Dehydration of Natural Gas, API, Spring Meeting, Southwestern District. Division of Production, Adolphus Hotel, Dallas, Tex., March 8-10, 1950.

Williams, Milton, Estimate of Interstitial Water From Electric Logs, AIME, Petroleum Branch Fall Meeting, Plaza Hotel, San Antonio, Tex., Oct. 5-7, 1949.

Williams, R. D. (Brown, R. H. and English, G. C.), The Role of Polarization in Corrosion, NACE, 1950 Conference and Exhibition, Hotel Jefferson, St. Louis, Mo., April 4-7, 1950.

Williamson, L. (Bloom, E. G., Mohler, F. L., Wells, E. J., and Wise, C. E.), Mass Spectra of C_5H_8 Isomers, J. Research Nat'l. Bur. Standards 43, 533-6, Dec., 1949.

Williamson, Laura (Bloom, E. G., Dean, H. M., Mohler, F. L., Wells, E. J., Wise, C. E.), Mass Spectra of Nonanes, J. Research Nat'l. Bur. Standards 44, 291-7, March, 1950.

Willingham, B. (Glasgow, A. R., Jr. and Rossini, F. D.), Hydrocarbons, in the 108 to 116 C Fraction, J. Research Nat'l. Bur. Standards 44, 141-5. Feb., 1950.

Willingham, C. B. (Glasgow, A. R., Jr. and Rossini, F. D.), Separation of 2, 3-Dimethylpentane, 1, cix-3-Dimethylcyclopentane, and 3-Ethylpentane from Petroleum. J. Research Nat'l. Bur. Standards 44, 411 8, April, 1950.

Willis, J. B. (Walsh, A.), Infrared Absorption Spectra at Low Temperatures, J. Chem. Phys. 17, 838, Sept.. 1949.

Wilson, Doyne (Randolph), Applications of Emulsion Drilling Fluids in California, API, Spring Meeting, Mid-Continent District, Division of Production, Skirvin Hotel, Oklahoma City, Okla., March 29-31, 1950.

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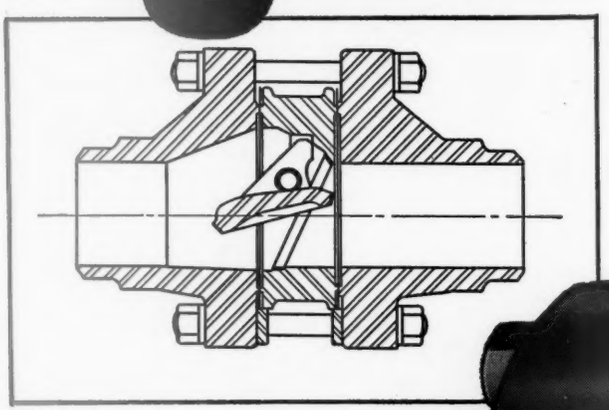
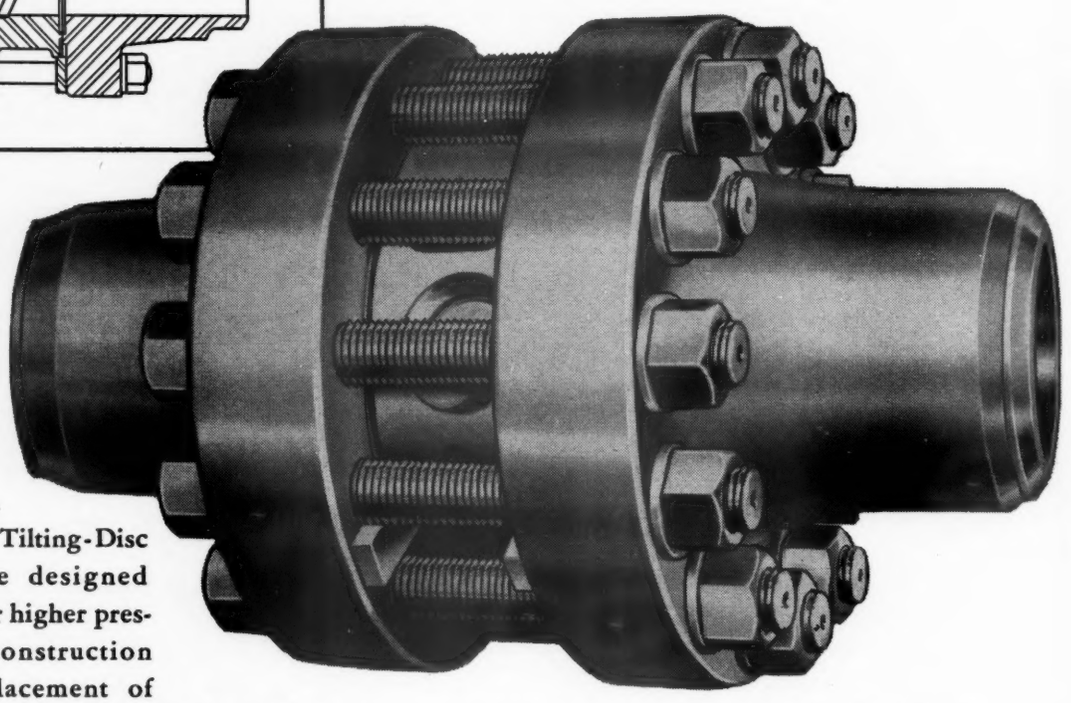
3 Piece Tilting-Disc Check Valve



Has Removable Center Section for Quick and Easy Replacement of Operating Parts



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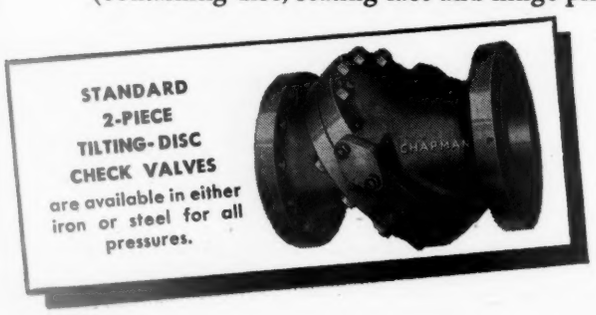

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BIBLIOGRAPHY—Classified list of important papers for 1949 - 1950

Wilson, G. E., Unsaturation in Hydrocarbon Oils, J. Inst. Petr. 36, 25-42, Jan., 1950.

Wilson, J. A. (Black, J. F., Dudenbostel, B. F., Jr., and Heigl, J. J.), Direct-Recording Raman Spectrometer, ACS, 116th Meeting, Division of Physical and Inorganic Chemistry, Atlantic City, N. J., Sept. 18-23, 1949.

Wilson, John F., Analysis of a High-Sulfur Cracked Distillate, API, Mid-Year Meeting, Division of Refining, Hotel Cleveland, Cleveland, Ohio, May 1-4, 1950.

Wilson, M. J. G. (Howland, A. H.), Chlorination of Methane, Fuel 28, 127-35, June, 1949.

Wilson, Robert E., API Wildcatting in Some Interesting Areas, API, 29th Annual Meeting, Stevens Hotel and Palmer House, Chicago, Ill., Nov. 7-10, 1949.

Wilson, Robert E., The Attitude of Management Toward Industrial Research, Engineer's Council for Professional Development, Edgewater Beach Hotel, Chicago, Ill., Oct. 28, 1949.

Wilson, W. H. (Kuhn, C. S. and Reichertz, P. P.), A Portable Resistivity Meter of Wide Range and High Sensitivity, API, Spring Meeting, Southwestern District, Division of Production, Adolphus Hotel, Dallas, Tex., March 8-10, 1950.

Winkler, C. A. (Greenblatt, J. H.), Reaction of Nitrogen Atoms With Ethylene, Can. J. Research (B) 27, 721-31, Aug., 1949.

Wire, R. W., What the Drilling Contractor Wants in Accident Prevention, AAODC, 5th Annual Drilling Safety Clinic, Crystal Ballroom, Baker Hotel, Dallas, Tex., June 15-16, 1950.

Wirges, M. F. (Palm, J. W.), Oxidation of Natural Gas, Oil & Gas J. 48, 90-2, 114, May 12, 1949.

Wise, C. E. (Bloom, E. G., Lengel, J. H., Mohler, F. L. and Wells, E. J., Jr.), Doubly Charged Ions in Mass Spectra, J. Research Nat'l. Bur. Standards 42, 369-78, April, 1949.

Wise, C. E. (Bloom, E. G., Mohler, F. L., Wells, E. J., and Williamson, L.), Mass Spectra of C_5H_8 Isomers, J. Research Nat'l. Bur. Standards 43, 533-6, Dec., 1949.

Wise, C. E. (Bloom, E. G., Dean, H. M., Mohler, F. L., Wells, E. J., and Williamson, Laura), Mass Spectra of Nonanes, J. Research Nat'l. Bur. Standards 44, 291-7, March, 1950.

Wise, C. E. (Bloom, E. G., Mohler, F. L., and Wells, E. J.), Metastable Transitions in Mass Spectra of Hydrocarbons, J. Research Nat'l. Bur. Standards 43, 65-70, July, 1949.

Wise, C. E. (Dibeler, V. H., Mohler, F. L., and Reese, R. M.), Introduction of Measured Liquid Samples into the Mass Spectrometer, J. Research Nat'l. Bur. Standards 44, 215-20, March, 1950.

Wise, R. B., Cooling-Water Slime, Oil and Gas J. 48, 170, 173, and 177-8, Feb. 23, 1950.

Withers, J. G. (Hulf, H. J. and Rubach, A.), An Ignition Delay Meter for the Determination of Cetane Number, J. Inst. Petr. 35, 485-95, July, 1949.

Wolf, H. R. (McCloud, J. L.), Automatic Transmission Fluid-Type A, For Passenger Cars, Petr. Refiner 29, 153-6, April, 1950.

Wood, B. D. (Allan, A. B., Durand, E. J., and King, R. O.), The Oxidation, Ignition, and Detonation of Fuel Vapors and Gases. XIII. The 12:1 Compression Ratio Performance of the C.F.R. Spark Ignition Engine Using Town Gas; Comparison With Diesel Engines, Can. J. Research (F) 28, 134-55, May, 1950.

Wood, Joe F., The Vapor Pressure of Liquefied Petroleum Gases, NGAA, 29th Annual Convention, Texas Hotel, Fort Worth, Tex., April 24-26, 1950.

Wood, R. E. (Dickinson, R. G. and Wallis, R. F.), Iodine-Sensitized Cis-Trans Isomerization of Dichloroethylene, J. Am. Chem. Soc. 71, 1238-45, April, 1949.

Woodruff, John, Vocational Training in Drilling and Productions Operations, API, Spring Meeting, Mid-Continent District, Division of Production, Skirvin Hotel, Oklahoma City, Okla., March 29-31, 1950.

Woods, W. W. (Hamilton, L. A.), Reaction of Iron With Organic Sulfur Compounds, ACS, 115th Meeting, Symposium on Organic Sulfur Compounds, San Francisco, Calif., March 27-April 1, 1949.

Woodward, Louis, Aerial Photogrammetry as Applied to the Petroleum Industry, AIME, Petroleum Branch Fall Meeting, Plaza Hotel, San Antonio, Tex., Oct. 5-7, 1949.

Woolfolk, E. O. (Dull, M. F., and Orchin, Milton), Phenols from Hydrogenation of Coal, ACS, 116th Meeting, Division of Industrial and Engineering Chemistry, Atlantic City, N. J., Sept. 18-23, 1949.

Woolfolk, E. O. (Fridel, R. A., Golumbic, G., and Orchin, M.), Partition Studies of Phenols. IV. Isolation of Indanols from Coal Hydrogenation Oils, J. Am. Chem. Soc. 72, 1939-42, May, 1950.

Wright, E. F., New Developments in Reciprocating Pumps, 6th Annual National Conference on Industrial Hydraulics, Sherman Hotel, Chicago, Ill., Oct. 18-19, 1950.

Wright, Fielding, L., Accomplishments of Conservation in Mississippi, IOCC, Summer Quarterly Meeting, Estes Park, Colorado, Sept. 1-3, 1949.

Wrigutson, F. M., Iron, Nickel, and Vanadium in Petroleum Oils, Anal. Chem. 21, 1543-5, Dec., 1949.

Wyllie, M. R. J. (Patnode, H. W.), The Presence of Conductive Solids in Reservoir Rocks as a Factor in Electric Log Interpretation, AIME, Petroleum Branch Fall Meeting, Plaza Hotel, San Antonio, Tex., Oct. 5-7, 1949.

Y

Yang, K. H. (Hougen, O. A.), Mechanism of Catalyzed Gaseous Reactions, Chem. Eng. Progress 46, 146-57, March, 1950.

Yellott, John I., Future Trends in Fuel Utilization and Conservation, UNSCCUR, United Nations, Lake Success, New York, N. Y., Aug. 17-Sept. 6, 1949.

Young, A. Russell, Economy Trends to Unitized Gas Compressor Installations, ASME, Regional Meeting of Region VIII, Baker Hotel, Dallas, Tex., March 30-April 1, 1950.

Young, D. P. (Mugdan, Martin), Catalytic Hydroxylation of Unsaturated Compounds, J. Chem. Soc., 2988-3000, Nov., 1949.

Young, H. D., Improved Method Devised to Estimate Cetane Number of Diesel Fuels, Petroleum Processing 5, 625-6, June, 1950.

Young, Hobart, D., Methods of Estimating Cetane Number, API, Mid-Year Meeting, Division of Refining, Hotel Cleveland, Cleveland, Ohio, May 1-4, 1950.

Young, W. S. (Dunn, E. B., Melpolder, F. W., and Taylor, R. C.), Description and Application of a Dual Automatic Potentiometric Titrimeter, API, Mid-Year Meeting, Division of Refining, Hotel Cleveland, Cleveland, Ohio, May 1-4, 1950.

Yundt, C. G. (Billheimer, J. S., Lacey, W. N., and Sage, B. H.), Methane-Decane-Tetralin-Bitumen System, J. Petr. Technol. 1, 265-70, Oct., 1949.

Yuster, S. T., An Evaluation of Relative Permeability Determination, AIME, Petroleum Branch Fall Meeting, Elks Club, Los Angeles, Calif., Oct. 20-21, 1949.

Yuster, S. T. (Heid, J. G., McMahon, J. J., and Nielsen, Ralph F., Permeability Studies, API, Spring Meeting, Southwestern District, Division of Production, Adolphus Hotel, Dallas, Tex., March 8-10, 1950.

Z

Zahn, Victor (Brooks, Francis R., Lykken, Louis, Milligan, William B.), Analysis of Gases by Absorption and Combustion, ACS, 115th Meeting, Division of Petroleum Chemistry, San Francisco, Calif., March 27-Apr. 1, 1949.

Zeder, J. C., The Road to Engineering Competence, SAE, National West Coast Meeting, Biltmore Hotel, Los Angeles, Calif., Aug. 14-16, 1950.

Zerwekh, C. E., Jr., Percent Transmission Computer for Infrared Spectra, Rev. Sci. Inst. 20, 371-2, May, 1949.

Zimmerschied, W. J. (Lien, A. P., and Higley, W. S.), Determination of Straight-Chain Hydrocarbons by Urea-Adduct Formation, API, Mid-Year Meeting, Division of Refining, Hotel Cleveland, Cleveland, Ohio, May 1-4, 1950.

CLASSIFICATION BY ASSOCIATION MEETING

American Association of Oil Well Drilling Contractors

Ninth Annual Meeting Baker Hotel, Dallas, Texas, Sept. 19-21, 1949

Diamond Core Bits, R. B. McCloy
Drilling Contract Forms, Hamilton Rogers
Hydraulic Power Transmitters, Nicholas A. D'Arcy
Operator's Response, Earl A. Brown
Review and Outlook for the Contractor, C. E. Reistle, Jr.
Rig to Office Communications, C. J. Paine and Jerry Stover
Selection of Drill Stem, Bruno Schabarum and Stanley Moore
The Balanced Rotary Rig, C. H. Oberg

Fifth Annual Drilling Safety Clinic, Crystal Ballroom, Baker Hotel, Dallas, Texas, June 15-16, 1950

Back Injuries in the Drilling Industry, Dr. John E. McDonald
Blow-Out Prevention Training for Drilling Wells, W. F. Rickards
Care and Maintenance of Wire Lines, R. D. McNutt
Crown Warning Device—The Rig Runner, T. W. Cooper
Eye Protection Standards for Drilling Industry, T. A. Walsh
How Experience Rating Works, Claude Pipes
New Practice for Eliminating Accidents in Off-Shore Operation, Jodie George
Reducing Hazards in Oilfield Truck Operations, Russell Fitzpatrick
What the Drilling Contractor Wants in Accident Prevention, R. W. Wire

American Association of Petroleum Geologists

Mid-Continent Regional Meeting, Skirvin Hotel, Oklahoma City, Oklahoma, Jan. 12-13, 1950

Age of Orogenic Movements in the Andarko Basin, Robert R. Wheeler
Geology of the Elk City Field, R. J. Beams
Geology of the Fort Worth Basin, J. B. Moorhead
Geology of the Hugoton Gas Field, J. D. McLean
Geology of the Lindsay Area, Garvin and McClain Counties, Oklahoma, Robert M. Swesnik
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Stratigraphy and Oil Possibilities of the Pennsylvanian System in Northwestern Oklahoma, Gerald C. Maddox
Stratigraphy and Structural History of the Sholem Alechem Field, Harold R. Billingsley
Stratigraphy and Structure of the Arbuckle Limestone in the Arbuckle Anticline, William E. Ham

Annual Meeting, Stevens Hotel, Chicago, Ill., April 24-27, 1950

Application of International Business Machines to Geological Data, Margaret A. Parker
Cycles, Henryk B. Stenzel
Exploratory Drilling, 1949, F. H. Lahee
Freedom and Petroleum Geology, C. W. Tomlinson
Geological Control of Methane Gas Accumulation in Japan, K. Uwatoko and Leo W. Stach
Geology and Geophysics of North Snyder Area, Scurry County, Texas, Clayton Neal
Geology of Quiriquire Oil Field, H. D. Borger
Geosynclinal Deposits in Central Gulf Region of United States, Grover E. Murray
Oil and Gas Possibilities in Post-Frontier Cretaceous Rocks of Wyoming, J. David Love
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Oil Shale in Part of Piceance Creek Basin, Northwestern Colorado, John R. Donnell
Paleogeographic Distribution and Classification of Reefs, E. C. Dapples, W. C. Krumbein, and L. L. Sloss
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Possible Future Oil Provinces of North America—Continental Shelf in Gulf of Mexico, Paul Weaver
Possible Future Oil Provinces of North America—Eastern Canada, J. F. Caley
Possible Future Oil Provinces of North America—Eastern United States, R. C. Lafferty
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Possible Future Oil Provinces of North America—Illinois Basin, David H. Swann
Possible Future Oil Provinces of North America—Mesozoic Downdip of South Texas, Paul B. Hinyard
Possible Future Oil Provinces of North America—Mexico, Manuel Alvarez, Jr.
Possible Future Oil Provinces of North America—Michigan Basin, Rex P. Grant
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Possible Future Oil Provinces of North America—Northern Mid-Continent States, Dollie Radler Hall
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Possible Future Oil Provinces of North America—Tertiary of South Texas, Hershal C. Ferguson
Post-War Exploration for Petroleum in Japan, Godfrey Kaufmann
Progress Report on Devonian Reef Exploration in Canada, W. J. Tellington
Redbeds and the Search for Oil, Gordon Rittenhouse
Some Physical Aspects of Ancient Reef Complexes, Robert R. Shrock
Structure-Forming Role of Limestone Reefs in Eastern Platform Area of West Texas, Gerson H. Brodie
Symposium on Possible Future Oil Provinces of North America—Alaska, George Gryc
Symposium on Possible Future Oil Provinces of North America—Pacific Coast States and Nevada, G. B. Moody
Symposium on Possible Future Oil Provinces of North America—Rocky Mountain Region, C. E Dobbin
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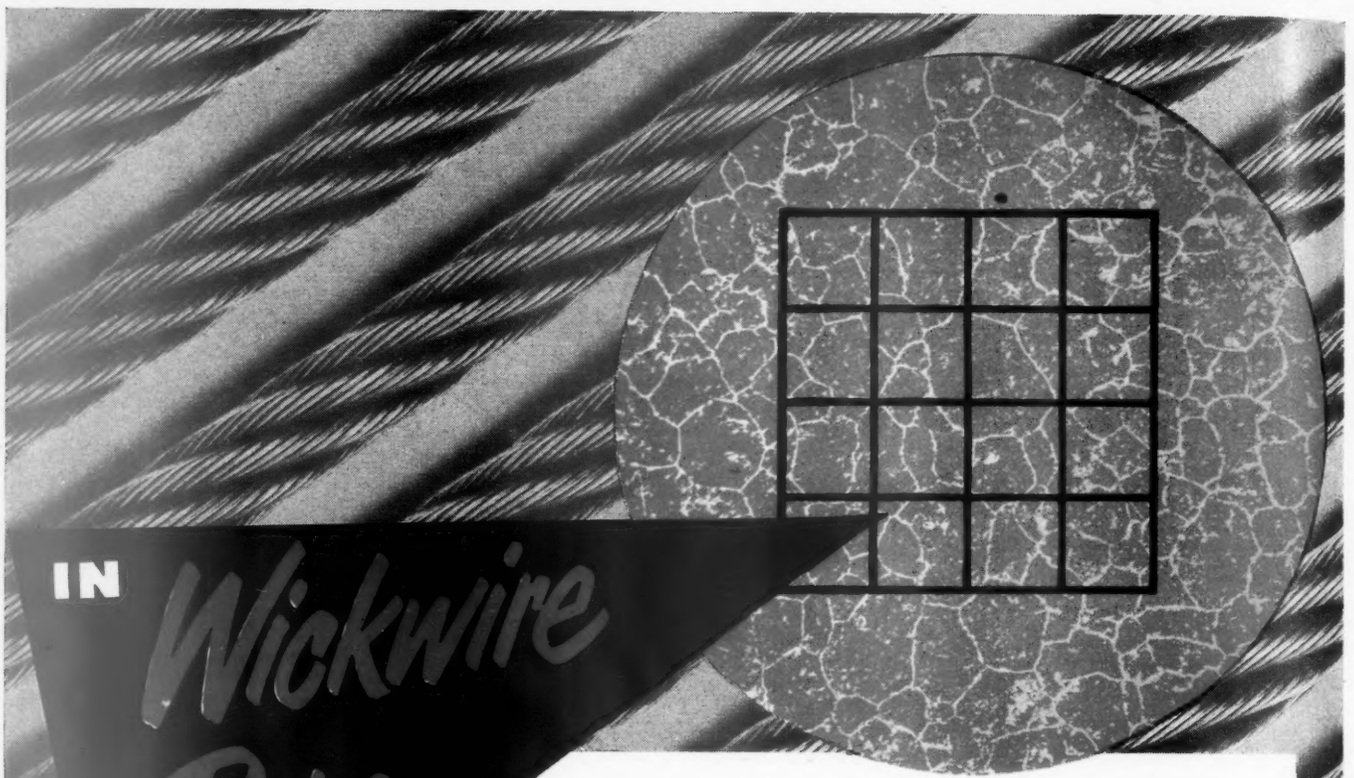

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BIBLIOGRAPHY—Classified list of important papers for 1949 - 1950

Symposium on Possible Future Oil Provinces of North America—West Texas, Ronald K. DeFord
The State of Seismic Prospecting, Andrew Gilmour
Transportation Facilities Utilized in Geological Exploration in Desert Terrain in Saudi Arabia, Richard C. Kerr
Types of Hydrocarbon Accumulation and Geology of South Liberty Salt Dome, Liberty County, Texas, Michel T. Halbouty and George C. Hardin, Jr.
Types of Oil and Gas Traps in Rocky Mountain Region, Alex W. McCoy, III., et al
Types of Oil and Gas Traps in Southern Oklahoma, Erwin L. Selk
Types of Oil and Gas Traps in West Texas and Southeast New Mexico, J. H. Bartley and Robert T. Cox

American Chemical Society

115th Meeting, San Francisco, Calif., March 27-April 1, 1949

Analysis of Gases by Absorption and Combustion, Francis R. Brooks, Louis Lykken, William Milligan, R. Nebeker Hazelton and Victor Zahn
Carbon Monoxide in Olefinic Gases, L. Donn, H. Levin, and P. R. Thomas
Chlorination of Saturated Hydrocarbons, Wilhelm Hirschkind
Cyclopentadiene from 1,3-Pentadiene, S. J. Hetzel and R. M. Kennedy
Determination of Small Amounts of Water, H. Levin and F. M. Roberts
Evaporation of Solvents and Thinners. Thin Film Evaporation vs Evaporation of Bulk Liquids and Instruments for Their Measurement, T. F. Bradley, R. J. Curtis, and J. R. Scheibli
Low Temperature Ethane Recovery Process, R. D. Barnard, W. E. Brown, R. G. Heitz, and C. F. Oldershaw
Microdetermination of Knock Characteristics of Motor Fuel, Julian Alexander, Jr. and Carl Pfeiffer
Micromethods for Petroleum Products, H. Levin, A. B. Morrison, and C. R. Reed
Reaction of Iron With Organic Sulfur Compounds, L. A. Hamilton and W. W. Woods
Quantitative Techniques With Carbon 14, George J. Atchison and William H. Beamer
Toluene Extraction From Petroleum, G. B. Arnold and C. A. Coghlan

116th Meeting, Atlantic City, N. J. Sept. 18-23, 1949

Adsorption Analysis by Displacement Techniques, John S. Ball, G. U. Dinneen, J. R. Smith, and C. J. Thompson
Chromatographic Analysis of Gas Oils for Hydrocarbon Types, R. J. Clerc, C. B. Kincannon, and T. P. Wier, Jr.
Determination of Bromine and Chlorine in Gasoline, C. M. Gambrill, B. Pecherer, and G. W. Wilcox
Determination of Traces of Sulfur in Organic Compounds, R. E. Holeton and A. L. Linch
Direct-Recording Raman Spectrometer, J. F Black, B. F. Dudenbostel, Jr., J. J. Heigl, and J. A. Wilson
Mechanism of Coal Hydrogenation, E. L. Clark. M. G. Pelipetz. and Sol Weller
Phenols from Hydrogenation of Coal, M. F. Dull, Milton Orchin, and E. O. Woolfolk

5th Southwest Regional Meeting, Oklahoma City, Okla., Dec. 10, 1949

Sulfur Compounds From Petroleum Hydrocarbons. Reactions and Derivatives of Tertiary Aliphatic Mercaptans, W. W. Crouch, W. A. Schulze, and G. H. Short

117th Meeting, Houston, Tex., March 26-30, 1950

Kinetics of Reaction Between Methane and Sulfur Vapor, R. A. Fisher and J. M. Smith

American Gas Association

31st Annual Convention Chicago, Ill., Oct. 17-20, 1949

Chemistry in the Gas Industry, F. E. Vandaveer
Costs and Problems in Storing BTU for Peak Gas Loads, Philip S. Parker
Development of a Corrosion Control Program, Pat H. Miller
Gas Structure Purging Practices, G. R. King
General Review of High BTU Operations, J. W. Carroll
Industrial and Commercial Gas Sales—The Balance Wheel of The Natural Gas Industry, D. A. Hulcy
Property Accounting for Natural Gas Pipe Line and Production Plant, R. H. Miller
Report of Corrosion Committee, Sidney E. Trouard
Should Depreciation be Discretionary, J. B. Jeming
The Use of Oxygen and Fuel Gas, E. G. deCoriolis

Distribution Motor Vehicles and Corrosion Conference Detroit, Mich., April 3-5, 1950

Cathodic Protection on the 840 Mile Texas Gas Transmission Corporation 26 Inch Pipe Line From Texas to Ohio, Robert J. Kuhn
Cathodic Protection to Bare Pipe Lines, Hugo W. Wahlquist
Experience With Magnesium Ribbon Type Galvanic Anodes, T. W. O'Brien
Fundamentals of Galvanic Corrosion, A. B. Lauderbaugh
Pipe Coating Reconditioning on Lines in Service, Wayne Schultz

Natural Gas Spring Meeting Tulsa, Okla., May 8-9, 1950

Natural Gas Reserves for the Future, N. C. McGowen
New Data on Use of Solid Dessicants, B. J. Sterk and E. Paul Wilkinson
The Gas Industry—Today and Tomorrow, H. H. Cuthrell
The Relation Between Higher Operating Costs and Rates —How Can Rates Help in a Solution, W. J. Herrman
The Relation Between Higher Operating Costs and Rates —The Problem of Increased Costs, B. C. Adams
The Relation Between Higher Operating Costs and Rates —Their Effect on Operations, Guy T. Henry
Trace Removals of Sulphur Compounds from Natural Gas, J. L. Oberseider
Transmission-Line Type Storage—Capacity Calculations and Cost, W. C. Mosteller

American Institute of Chemical Engineers

10th Regional Meeting Los Angeles, Calif., March 6-10, 1949

Batch Azeotropic Distillation. Effect of Charge Composition on Recovery, L. Berg, H. C. Carpenter, and J. B. Daly
Problems of Combustion. Liquid-Propellant Rocket Motors, R. B. Canright

Boston Regional Meeting, Swampscott, Mass., May 28-31, 1950

Boiling Coefficients of Heat Transfer for C_4 Hydrocarbons-Furfural Mixtures Inside Vertical Tubes, W. E. Bonnet and J. A. Gerster
Catalyst-Gas Mixing in Commercial Equipment, J. W. Askins, G. P. Hinds, Jr., and Fred Kunreuther
Catalytic Reactions at High Pressures and Temperatures, G. G. Brown and C. M. Sliepsevich
Equilibrium State of Catalysts in Moving Bed Reactor Systems, Nolan Poffenberger and R. S. Spencer
Physico-Chemical Effects of Ultrasonics, Alfred Weissler
P-V-T Relations of Gases, H. P. Meissner and R. Seferian
The Background, Education and Selection of Engineers, A. L. Miller and P. C. Miller
The Gasification of Carbon with Metal Oxides in a Fluidized Powder Bed, E. R. Gilliland, W. K. Lewis, and M. P. Sweeney
The Uniformity of Fluidization—Its Measurement and Use, C. O. Ballou and R. D. Morse

American Institute of Chemists

Mid-Century Meeting, New York, N. Y., May 12, 1950

Petroleum Chemicals 1950 and 2000, Gustav Egloff

American Institute of Mechanical Engineers

Petroleum Branch Fall Meeting, San Antonio, Tex., Oct. 5-7, 1949

Ability of Drilling Muds to Lift Bit Cuttings, H. N. Hall, Frank Nuss, and Howard Thompson
Aerial Photogrammetry as Applied to the Petroleum Industry, Louis Woodward
Analysis of Fractional Limestone Cores. F. C. Kelton
An Electrical Computer for Solving Phase Equilibrium Calculations, J. M. McDowell and Morris Muskat
An Electronic Analog Computer for Solving the Flash Vaporization Equilibrium Equation, F. W. Bubb, Paul G. Carpenter, and Robert G. Nisle
Applications of the Telefloodmeter to Water Flooding, Quentin B. Marsh
Attainment of Connate Water in Long Cores by Dynamic Displacements. R. L. Slobod
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Critical Analysis of the Effect of Well Density on Recovery Efficiency, F. H Callaway and W. O. Keller
Current Problems in Cycling Operations, Alton J. Carroll and Ralph Hock
Cycling Operations in the LaGloria Field, William Justice
Determination of Friction Factors for Measuring Productivity of Gas Wells. R. V. Smith
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Lost Reserves, C. W. Tomlinson
Performance Characteristics of a Volumetric Condensate Reservoir, F. H. Allen and R. P. Roe
Pore Size Distribution of Petroleum Reservoir Rocks, N. T. Burdine, Luke S. Gournay, and P. P. Reichertz
Primary Pressure Maintenance With Water Injection in the New Hope Field, Franklin County, Texas, Sam N. DeWitt and A. S. Trube, Jr.
Relation Between Electrical Resistivity and Brine Saturation in Rocks, C. R. Bailey, H. L. Bilharts, H. F. Dunlap, and Ellis Shuler
Relative Permeability to Gas, L. H. Jenks, W. J. Leas, and Charles D. Russell
Selective S. P. Logging, Henri G. Doll
Some Preliminary Investigations of Quantitative Interpretations of Radioactivity Logs, Robert E. Bush and E. S. Mardock
The Presence of Conductive Solids in Reservoir Rocks as a Factor in Electric Log Interpretation, H. W. Patnode and M. R. J. Wyllie
The Solubility of Carbon Dioxide in Water Both Without and in the Presence of Porous Media, R. L. Huntington and V. Fred Thomas
The Water Vapor Content of Essentially Nitrogen-Free Natural Gas Saturated at Various Conditions of Temperature and Pressure, W. L. Boyd, E. L. McCarthy and L. S. Reid
Vaporization in Porous Media Due to Velocity Differences, Charles E. Guthrie, Donald L. Kats, and Floyd W. Preston
Wave Forces Computed for an Offshore Drilling Site, Paul L. Horrer
When Do We Need a Synthetic Fuel Industry, A. L. Solliday

Petroleum Branch Fall Meeting Los Angeles, Calif., Oct. 20-21, 1949

An Evaluation of Relative Permeability Determination, S. T. Yuster
Corrosion Mitigation Within Dehydrating Tanks, Ernest O. Kartinen
Cuyama Valley Oil Field, Chester A. Davis and W. A. Payne
Fluid Saturation in Porous Media by X-Ray Technique, A. D. K. Laird and J. A. Putnam
Improved Casing Cementing Practices in the United States, William D. Owsley
Lakeview Pool, Midway-Sunset Field, W. G. Frailing and W. P. Sims
Recent Canadian Oil Developments, J. D. Gustafson
Recent Developments in Offshore Drilling, Gulf Coast, Dean A. McGee
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The SP Log in Shaly Sands, H. G. Doll

Annual Joint Meeting, Texas Sections, College Station, Tex., Dec. 8-9, 1949

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A Discussion of Some Important Factors Contributing to Corrosion Fatigue of Drill Pipe, Riley V. Carlton
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An Economic Analysis of the Water-Flooding of Oil Sands in North Texas. William F. Nicodemus
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The Jet Process of Open Hole Shooting and Casing Perforating. R. H. McLemore
The Time Factor in Cementing, Bruce Barkis
Uses of Plastics in Sand Consolidation, Edward F. Kelly
Well Completion Fundamentals, H. T. Kennedy

(To be continued)

LAUGH with BARNEY

Three polar bears were sitting on an iceberg.

"Now," said the father polar bear, "I've got a tale to tell."

"I, too," said the mother polar bear, "have a tale to tell."

The little polar bear looked up at his parents and said: "My tail's told."

Said one broomstick to the other: "Let's be broommates so we can sweep together, dust for the fun of it."

When a woman driver puts her hand out, you may be sure of one thing—the window is down.

Mary had a little wolf; she fleeced him white as snow.

A guy wandering through a department store squeezed one doll and it cried "Mama." Later he squeezed another doll and it screamed, "Floorwalker!"

Pressman: I miss the old cuspidor since it's gone.

Janitor: You missed it before—that's why it's gone!

Rastus: What all did de doctor say's de matter wid you?

Liza: He says I's sufferin' from acute indiscretion.

There was the absent minded professor who sent his wife to the bank and kissed his money goodbye. On second thought, he wasn't so absent minded—was he?

A stout, middle-aged suburbanite was explaining his tennis technique.

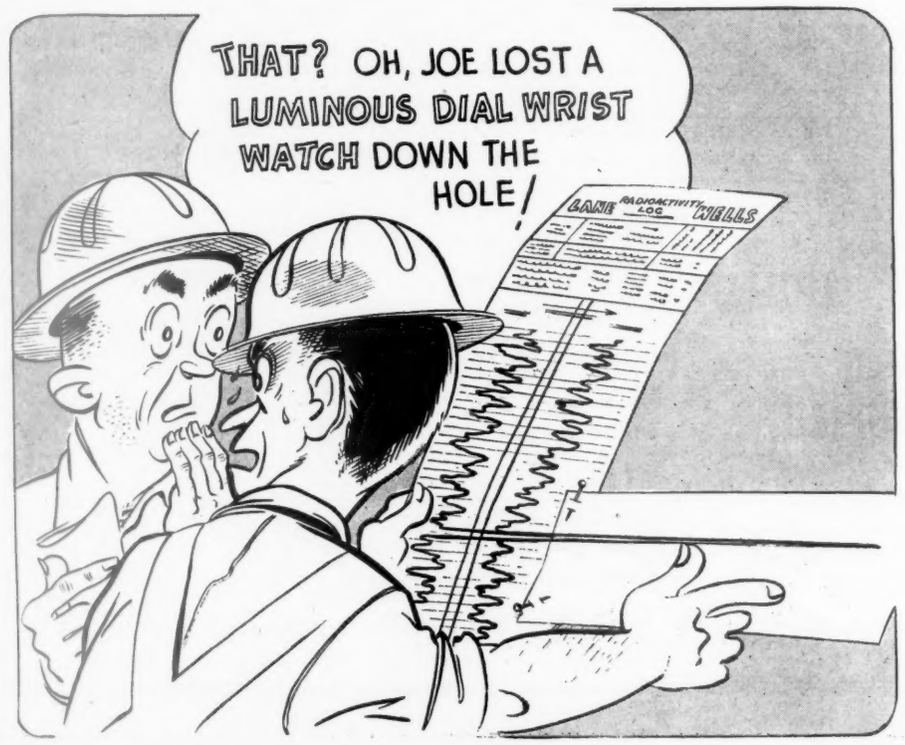
"My brain barks a command to my body. It says: 'Run forward speedily. Slam the ball over the net. Then run back and get into position for the next shot'."

"Then what happens?" he was asked.

"Then," he replied, "my body says: 'Who, me?' "

At the corner cigar store: Greatly agitated, a mother dashed into a drug store carrying her infant child. "My baby swallowed a .22 calibre bullet!" she cried. "What shall I do?"

"Give it the contents of a castor oil bottle," replied the druggist calmly. "but don't point him at anyone."



On the plant time-clock for tardy workers to see: "The absent-minded professor had an old cuckoo clock in his bedroom. One morning the clock went out of order and cuckooed twenty-seven times. He jumped out of bed in a panic, crying, 'Good grief, that's the latest I've ever been!' "

A Tory candidate during the recent English election campaign was speaking when he was interrupted by a socialist in the audience with:

"Why have we the finest generation of children ever known in this country?"

Retorted the heckler number 2 from the back of the hall: "Because they were produced by private enterprise!"

Both women and pianos
Are similar in brand.
Some of them are upright
And some of them are grand.

Lady: Doctor, why does a small cavity feel so large to the tongue?

Dentist: Just a natural tendency of the tongue to exaggerate, I suppose.

"Dad, what is the difference between Capital and Labor?"

"It's like this, son; the money you loan represents Capital — getting it back implies Labor."

The worried countenance of the bridegroom disturbed the best man. Tiptoeing up the aisle, he whispered:

"What's the matter, Jock? Have ye lost the ring?"

"No," blurted out the unhappy Jock, "the ring's safe eno'. But, mon, I've lost ma enthusiasm."

A man, seated in the dentist's chair, heard a radio blaring. "Would it be possible," he asked the dentist, "to stop that radio? I know six teeth have to come out but I don't want it done to the tune of 'The Yanks Are Coming'."

Said the absent-minded man leading his hungry spouse to a seat by the counter of the lunch room near the gas station: "Fill'er up!"

Visitor (to Arizona native): Say, what's the death rate around here?

Native: Same as anywhere else, bub. One to a person.

After the Game . . .

Sis: Oh, dear! his nose is broken!

Ma: Yes, and he's lost a front tooth!

Dad: Yea, but he didn't drop the ball!

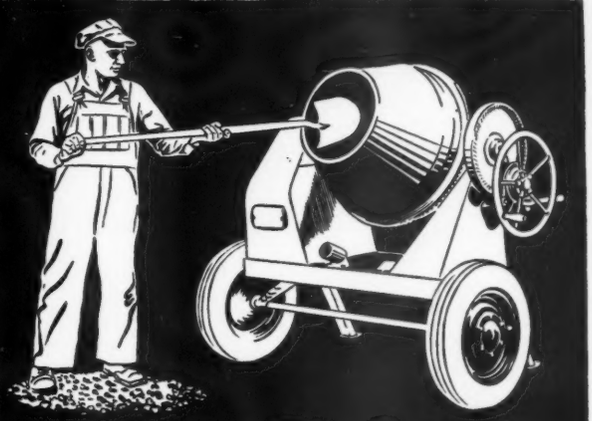
PORTABLE 1-BAG MIXER re-mixes every batch...

For top-quality concrete produced at top speed . . . on any location . . . check the extra time and money-saving advantages this handy Kwik-Mix 6-S DANDIE offers you. You get sturdy construction without overweight for frequent moves on your job . . . leaf springs and pneumatic tires cushion the rigid frame against road and operating shocks. It's smooth-trailing, easily spotted by hand at pouring-location.

You get thorough-strength mix every batch because the Kwik-Mix re-mixing drum adds a lateral folding action to the customary up-and-down mixing motion . . . completely cement coats each aggregate. Automatic water-measuring tank accurately discharges water to within fraction of a pint . . . when skip raises, water valve trips automatically starting flow into drum at precise moment to eliminate clogging. Power-raised skip and Selective Skip Shaker for faster charging . . . plus tilted Flow-Line discharge chute . . . save seconds every batch, more batches per hour. One man can handle all operations.

For high-speed mixing and hauling, team Kwik-Mix DANDIE mixers with the new Moto-Bug, shown above with 6-S. This new, low-cost power wheelbarrow holds 10 cu. ft. . . . travels 1½ to 4 m.p.h. forward and reverse. Send coupon for complete facts.

DANDIE—Trademark Reg. U. S. Pat. Off.



UTILITY-SIZE 3½-S DANDIE EARNS BIG SAVINGS ON SMALL JOBS

Kwik-Mix 3½-S Dandie pays off on scattered, small-quantity mixing assignments . . . gives you high-quality concrete mixed fast, at low cost, anywhere on your property. It's portable as a wheelbarrow. Balanced, light weight and handy push-down towpole provide safe, one-man handling. Large drum opening and low, 3½' shoveling height give fast, easy charging . . . mean more concrete mixed per shift. Convenient end discharge eliminates backing and turning loaded wheelbarrow . . . gets barrow loaded and on its way with ½ the usual effort. Available with either tilting drum (illustrated), or non-tilting.

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Name.....Title.....

Company.....

Street.....

City.....Zone.....State.....

Oil and Gas Trade News

Green Head Supply Sold

Paul Snetcher, of Oklahoma City, Oklahoma has announced the sale of the remaining physical assets of Green Head Supply Company to Charles Brogan and Chet Matthews, who will operate the business as a partnership, under the name of Green Head Service. Brogan and Matthews were associated with Green Head Supply Company for many years prior to the sale of this company to Mid-Continent Supply Company. Snetcher, a widely known figure in the oilfields, recently purchased the capital stock of Drilling Equipment Manufacturing Company, of Oklahoma City.

Worthington Names Agent

Ray Friel, owner of Friel-Detroit Company, Detroit, Michigan, announces a recently signed distributorship agreement to sell and service Worthington Pump and Machinery Corporation Air Compressors for all types of service stations, bulk plants, and garages. The Friel-Detroit Company supplies Detroit and a 100-mile radius with air compressors, hoists, storage tanks, centrifugal and rotary pumps, meters, gasoline pumps, and all types of lighting for gasoline stations, petroleum distributors, and industrial plants. The company's staff includes: John Peebles, sales manager; Ray Gier, service station equipment specialist, and Miss Mary Vizza, office manager.

Kaiser Buys 450 Acres

Kaiser Steel Corporation has disclosed it has taken options on approximately 450 acres of land adjoining the Fontana Works' 1300-acre plant site. George B. McMeans, Fontana works manager, said that the company plans to hold the property for possible use in the future development of the steel mill. One parcel extends west from the mill, running north from San Bernardino Avenue. The second parcel is west of the Fontana Mineral Wool Insulations Company on the south side of San Bernardino Avenue.

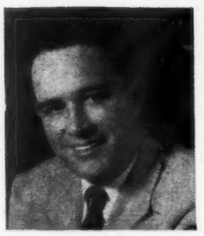
Industrial Engine Men Guests of Home Office

Fifty-one dealers and key men in their organizations attended a four-day conference held by the industrial engine division, Chrysler Corporation, in Detroit recently. Meetings were held in the auditorium of the administration building of the Chrysler Jefferson plant. The program largely was given over to what might be termed a "clinic," in which every possible phase of selling and servicing industrial engines of Chrysler manufacture was discussed.

Company spokesmen told of plans for further expanding business in this branch of Chrysler Corporation. Service matters were extensively discussed and engine adaptation occupied the greater part of two days.

Division Managers' Meeting

The division managers of Fluid Packed Pump Company recently met at the Tulsa Hotel to discuss plans for expanding sales and service facilities for Oilmaster Pumps. The meeting was attended by J. B. Reilly, president and general manager; M. S. Black, plant manager; Sidney Shuman, general sales manager; Glen W. Peters, assistant sales manager; G. R. Newbolt, manager of Oklahoma and Kansas; C. D. Newbolt, manager of Gulf Coast, East Texas, Louisiana, Mississippi, and Arkansas; B. G. Wing, manager of the eastern division; and Dee A. McDaniels, manager of North Texas, West Texas, New Mexico and the Panhandle.



Sidney Shuman

Dallett Tools Now Produced in Houston

The Dallett Company of Philadelphia, Pennsylvania which was purchased in 1947 by the Reed Roller Bit Company, has been moved to the Cleco division plant in Houston, Texas, where production of Dallett tools and accessories is now in progress. The combined facilities of the Reed Roller Bit Company in Houston cover 42½ acres of land.

Guests of the four-day conference held by Chrysler Corporation in Detroit, Michigan.

Headquarters of Wellite Corporation, Tulsa, Oklahoma, by night. Distribution points are in Texas, Louisiana, Mississippi, New Mexico, and Oklahoma.

Canadian Plant Set Up

To provide increased service for its expanding Canadian business, Gardner-Denver Company, manufacturer of rock drills, air compressors, pumps and equipment for mining, contracting, oil field, and industrial purposes, is establishing a Canadian plant, officials of the company announce. The new plant will be situated at Brantford, Ontario, and will be operated by Gardner-Denver Company (Canada) Limited. Key production men will be temporarily transferred from the parent plant, Quincy, Illinois, to provide the necessary initial supervision, but both skilled and unskilled labor will be obtained in Canada.

Valve Division Formed

H. K. Porter Company, Inc., Pittsburgh, Pennsylvania, announced the formation of Jarecki valve division, Tulsa, Oklahoma, to handle the manufacture and sale of Jarecki valves formerly produced at Jarecki Manufacturing Company plant in Erie, Pennsylvania. Established in 1852, the Jarecki Company manufactured a complete line of iron and bronze valves and cocks. These will now be produced in H. K. Porter's Hinderliter Tool Company Division plant at Tulsa, Oklahoma.

Industrial Companies Merge

C. H. Wheeler Manufacturing Company of Philadelphia, Pennsylvania, and Economy Pumps, Inc., and Klipfel Valves, Inc., both of Hamilton, Ohio, have recently announced their merger. No change at the present time in personnel or operation of any of the companies is planned, according to L. G. L. Thomas, president of the three companies. The merger brings together three companies long known to the power field. C. H. Wheeler has been designing and building steam condensing, vacuum producing, and water cooling equipment for more than 50 years. Economy Pumps, Inc. has been known for almost 40 years as a manufacturer of centrifugal pumps in capacities up to 200,000 gal per minute. Klipfel Valves, Inc., founded in 1904, manufactures automatic regulating valves, which are used in power plant equipment.

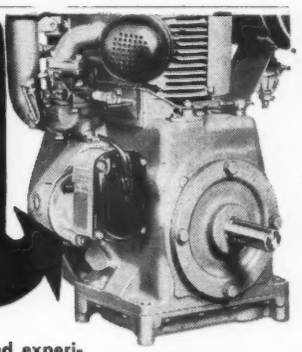
Kaylo Names Agents

The Kaylo division, Owens-Illinois Glass Company, Toledo, Ohio, has announced the appointment of Reilly-Benton Company, Inc., New Orleans, Louisiana, as distributors of their Kaylo heat insulation for the area of Louisiana and Mississippi. Reilly-Benton is solely wholesale distributors of insulation materials and accessories engaging in no application work. It maintains sales representatives at New Orleans, for the state of Louisiana, and Jackson, for the state of Mississippi. Kaylo heat insulating coverings are made of hydrous calcium silicate.

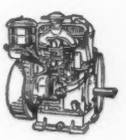
Branch Manager Named

Ralph S. Lorimer has been appointed branch manager of The National Supply Company's new Washington, D. C. office. Lorimer brings to National Supply a background in diesel engineering that dates back to 1917, the year he joined the Atlas Imperial Diesel Engine Company of which his father was one of the founders. He has been engaged in almost every phase of diesel engine manufacturing, including development work, field engineering, production, sales, and was, prior to joining National Supply, in charge of the Lorimer Diesel Engine Company.

Why WISCONSIN HEAVY-DUTY Air-Cooled ENGINES Have a Rotary-Type OUTSIDE MAGNETO



Wisconsin engineers have found through long experience and experimentation that the best place to put the magneto, not only for convenient accessibility but for better ignition performance over an extended period of time is on the OUTSIDE . . . with an independent, direct drive from the engine to the Magneto. The Rotary Type high tension magnetos used on Wisconsin Air-Cooled Engines provide the greatest protection against ignition troubles because the Magneto itself is a complete, independent operating unit that doesn't rely on an unrelated part of the engine for its successful operation. It's tightly sealed against dust and moisture, and there is no chance of it getting "fouled up." Oil field operators report that it is not unusual for big 80 to 100 hp. gas engines to run an entire year, 24 hours a day, with no repairs other than possibly a new set of points, when equipped with exactly the same type of magneto as used on all Wisconsin Engines.



Yes, the MAGNETO is important . . . both as to type and placing on the engine. It's the right kind and in the right place on Wisconsin Heavy-Duty Air-Cooled Engines. Specify "Wisconsin" for your 3 to 30 hp. power needs . . . Descriptive literature on request.

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World's Largest Builders of Heavy-Duty Air-Cooled Engines

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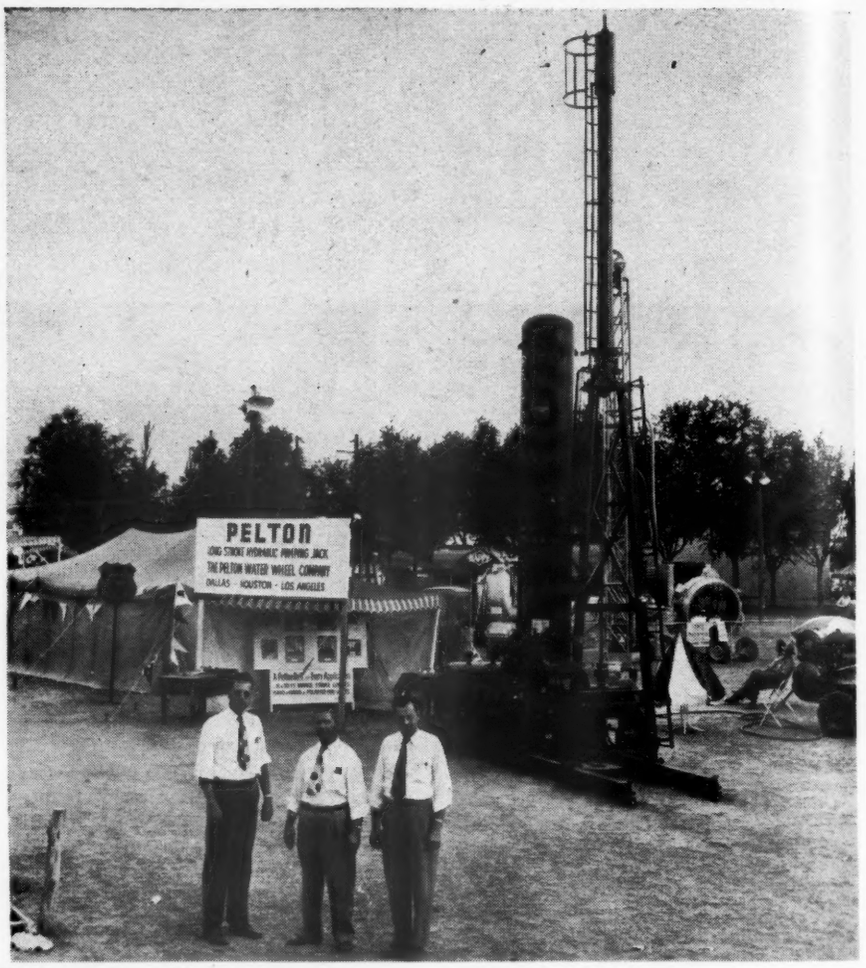
Safety Council Awards American Steel Plants

Two plants of the American Steel and Wire Company, at Cleveland, Ohio, and Trenton, New Jersey, have been honored by the National Safety Council for outstanding safety performances during the past two years. The company's central furnaces and docks plant at Cleveland received two awards. One was a National Safety Council award for its record of 1,404,438 man-hours without lost-time accident in the 15-month period ending March 31 of this year. This performance has been maintained since then, reaching the figure of 1,875,000 man-hours on November 14. In addition, the plant received an award from the Safety Council in recognition of its accident-free performance during the one-year period ending on June 30 of this year. The award to the Trenton plant is based on its record of 1,152,503 man-hours without lost-time accident during the period of August 9, 1949, to June 30, 1950.

The Trenton plant has continued its accident-free performance, reaching the figure of 1,647,952 man-hours on November 1. Central Furnaces has 532 employees; Trenton Works employs 787 people. Central Furnaces comprises 2 blast furnaces, loading and unloading docks.

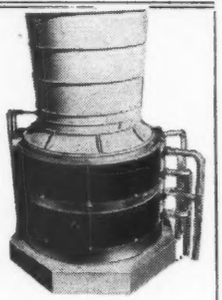


Oil Show Exhibit. Pelton Water Wheel exhibited its Model "D" hydraulic pumping jack recently at the Permian Basin Oil Show in Odessa, Texas. This model is designed for a polished rod load of 20,000 lb, and twelve 10-ft strokes per minute.

Pritchard's *New*

Type "E" Quintair*

AIR COOLED HEAT EXCHANGER



For Low Cost, Efficient Cooling or Condensing of Liquids, Gases or Vapors

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Foreign Companies Receives Licenses

To further expand its world-wide facilities, Key Company, East St. Louis, Illinois, announces the licensing of three foreign companies to manufacture Key return bend fittings for the oil refinery and allied chemical industries. Under this arrangement, all Key designs, research and engineering facilities are made available to the three licensees. The companies selected are:

Lake and Elliot, Ltd., Braintree, Essex, England; Societe Francaise des Constructions, Babcock and Wilcox, Paris, France, and Compagnia Tecnica Industrie Petroli, Rome and Milan, Italy. Prior to World War II, Key Company had such a manufacturing agreement with the companies in Italy and France. The result in quicker, more efficient service to customers was such as to warrant the renewal of these licensing agreements.

Carlisle Forms New Firm

F. M. "Mack" Carlisle announced recently the formation of a new firm bearing his name —F. M. Carlisle and Associates. The new company distributes two oilfield products: Crete-o-Lite, a light weight aggregate for oilfield cementing work, and Circ-u-Lite, a lost circulation additive. Both products, it was stated, are manufactured to specifications by the Paramount Perlite Company of Paramount, California.

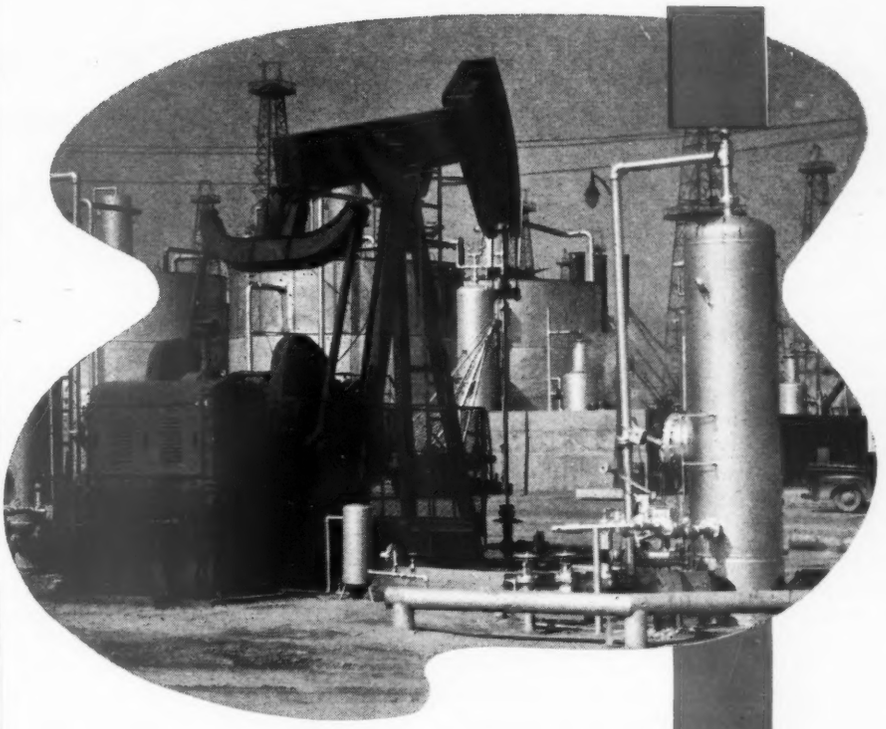
F. M. Carlisle

Reports on Nodular Iron

The time is not far off when such items as high-pressure compressor cylinders, supercharged diesel engine crankshafts, pistons and other parts subject to severe mechanical service will be produced from the new nodular iron, according to T. E. Eagan, chief metallurgist of The Cooper-Bessemer Corporation. Many highly stressed engine and compressor parts which heretofore have been produced from more costly cast steels or steel forgings, can now be successfully made from nodular iron, explains Eagan. Speaking before regional meetings of the American Foundrymen's Society in Los Angeles, San Francisco, California, Portland, Maine, and Seattle, Washington. Eagan disclosed that nodular iron is now being produced possessing tensile strengths exceeding 90,000 psi. Ductility is averaging 10 times that possible with cast iron. Fatigue tests conducted on high pressure cylinders are demonstrating that nodular iron equals and in many cases exceeds the fatigue endurance that can normally be carried with mild cast steel.

Baroid Sales To Move Offices To Houston

The general offices of the Baroid sales division of National Lead Company, including the sales, administrative, and research departments, will be moved from the Los Angeles headquarters to Houston, Texas. The Baroid division is a maker of products for drilling muds used in connection with the drilling of oil wells. Contracts have been let to construct a 40,000 sq ft steel and concrete two-story headquarters building in Houston, with completion scheduled for July 1 occupancy. Houston has been headquarters for Baroid's Gulf Coast division, with offices in the City National Bank.



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STOPS RUST!

Add years to the useful life of tanks, pipes, derricks, fences, buildings, roofs and other metal properties by protecting them with RUST-OLEUM. It's a tough, pliable coating that seals metal against the ravages of rain, dampness, salty air, weathering and many destructive elements that attack your plant twenty-four hours a day.

Originally developed to combat the most damaging rusting conditions, RUST-OLEUM is widely used by petroleum plants from coast to coast. It has proved its capacity to meet many of the needs of the industry for dependable, long-lasting anti-rust protection.

RUST-OLEUM can be applied without extensive preparation . . . even over surfaces that are already rusted. RUST-OLEUM spreads evenly . . . free of brush marks . . . and dries to a firm, elastic, rust-resistant film.

The time and labor saved in applying RUST-OLEUM mean substantial savings to you in maintenance costs. Yet RUST-OLEUM costs no more than most quality materials.

RUST-OLEUM is decorative, too! It's available in a large selection of colors including white and aluminum.

RUST-OLEUM is stocked and sold by leading industrial distributors in all principal cities in the United States and Canada. If you have a trouble-some rust problem, write for your copy of our catalog which contains full information and recommendations for use.

See our complete catalog in SWEET'S

RUST-OLEUM CORPORATION

2551 Oakton Street **Evanston, Illinois**

Trade Personals

▸ **R. F. Attner** has been appointed manager of valve distributor sales of Manning, Maxwell & Moore, Inc. Since 1945, assistant to the sales manager for Hancock Valves at Watertown, Massachusetts, Attner joined the company in 1922 as an inventory clerk later moving into a production department.

▸ **Charles H. Eisenhardt,** who began with American Steel and Wire Company's sales department as a stenographer 25 years ago, has been named manager of the electrical products sales division of this U. S. Steel subsidiary. Eisenhardt, who has been assistant manager of the division since March, 1944, succeeds **T. F. Peterson,** resigned. A native of Baltimore, Eisenhardt attended schools in that city, and began with the company in its Baltimore sales office in May, 1925.

▸ **John L. Smith,** United Supply and Manufacturing Company, has been named division manager of the West Texas area. Smith was promoted from his former job as district manager. His headquarters will be in Midland, Texas. New district manager of the southern area of West Texas is **Roger Northup** with headquarters in Midland. Northup was formerly assistant district manager. West Texas northern area district manager is now **L. W. Moore** whose headquarters will be in Hobbs, New Mexico.

▸ **Albert E. Binger, Jr.,** has been appointed to the position of industrial sales manager, the Philip Carey Manufacturing Company, Lockland, Ohio. Binger has been sales manager of the built-up roofing and paint department, joining Carey in early 1949 after serving in various executive positions.

▸ **T. M. Curtis** has been appointed sales manager of the southern division of Cook Electric Company, Chicago, Illinois. His offices are at 6617 Snider Plaza, Dallas, Texas.

▸ **R. J. Howison,** general sales manager of the Morse Chain Company, division of Borg-Warner Corporation, Ithaca, New York and Detroit, Michigan has been recently appointed as Morse Western Factory Representative.

He will supervise the sales of Morse Mechanical Power Transmission products in the eleven states west of and including Montana, Wyoming, Colorado, and New Mexico. Becker's headquarters are at 1571 Harding Ave., Pasadena 7, California.

Becker formerly was associated with the J. W. Minder Chain and Gear Company, Los Angeles, who are Morse Chain distributors in this area.

Well Logging Conference. Schlumberger Well Surveying Corporation held the first in a series of regional study conferences in Houston, Texas, recently. The conference covered topics in the general fields of well logging, theory, interpretation, and applications. (In the photo those names that do not have a company after them are Schlumberger men.) First row W. O. Matejowsky; R. D. F. Anderson, Atlantic Refining; T. L. Hird; A. L. Draper, Humble Oil and Refining; J. B. Justus, The California Company; Jim Lewark, Carter Oil; G. E. Hendrickson, Cities Service; Lee Petty; L. H. Reynolds; Lee Meltzer, United Gas Corporation; D. M. Cowart; G. K. Sievers, Carter Oil. Second row: R. G. Sweeney, Arkansas Louisiana Gas; J. S. Coombs; R. Wills, Magnolia Oil; D. T. Wise, The Texas Company; C. H. Coldwell, Sun Oil; C. R. Edgecomb; Fred McMillan, Phillips Petroleum; Donald Loehendorf, Magnolia Petroleum; H. B. Baskette; Carl Schwab, G. R. Brown; W. G. Barfield; W. T. Ilfrey, Humble Oil and Refining; J. C. West; W. A. Eickmeyer; W. W. Shoquist; J. L. Heath, Jr. Third row: W. W. Goode, Jr., T. R. Elliott; W. H. Hartsell; W. B. Emery, Ohio Oil; J. C. Byers, Sun Oil; E. R. Atkins, Union Oil of California; G. H. Thomen; Garrett; Max Taves, Richfield Oil; R. P. Ridley, Texaco; A. Bland, Imperial Oil; B. H. Clark, Magnolia Petroleum. Visitors' special problems were taken into consideration.

C. E. Wilson R. A. Anderson W. C. Flanders W. H. Zeis

▸ **Charles E. Wilson** has been elected chairman of the board of directors of the Worthington Pump and Machinery Corporation's subsidiary, Worthington-Gamon Meter Company. **Robert R. Anderson** has been elected president, **William C. Flanders,** vice president in charge of sales, and **Walter H. Zeis,** secretary-treasurer. Wilson has served as president of Worthington-Gamon since 1946. In addition to his duties as chairman of the board of the subsidiary, Wilson continues as a vice president of the parent company. Anderson, newly-elected president of Worthington-Gamon, joined that organization in 1922. In 1932 he was elected treasurer, and in 1942 vice president. Flanders joined Gamon Meter in 1925 as sales representative in New Jersey and was appointed sales manager of Worthington-Gamon in 1937. Zeis began his career with Worthington in 1925 and served in various accounting capacities until his election as treasurer of the subsidiary company.

▸ **Clifford Off, Jr.,** and **Harry E. Rapp** have been appointed to the board of directors of the Insul-Mastic Corporation of America, whose offices are in Pittsburgh, Pennsylvania. Off is sales manager of the company. He joined the Insul-Mastic staff in 1946 after having served with the United States Navy in the Pacific as Commander of an LST. Rapp joined Insul-Mastic in 1947 and now holds the position of technical director.

▸ **Robert E. Owen,** Gar Wood Industries, Inc., Wayne, Michigan has been appointed district manager in the Southwest region of the U. S. He will be responsible for the sale and service of Wayne Division products in Texas, New Mexico, Oklahoma, Kansas, western half of Missouri, and part of Arkansas. Dwight L. Mink has been named district manager in the Midwest region of the U. S. He will handle sales and service in Wisconsin, Illinois, Kentucky, and parts of Michigan, Ohio, Missouri, Iowa, and Indiana.

▸ **H. K. Ihrig** has been elected vice president in charge of research, Allis-Chalmers Manufacturing Company, Milwaukee, Wisconsin. Simultaneous with this announcement, W. C. Buchanan, president of the Globe Steel Tubes Company, Milwaukee, and a director of Allis-Chalmers, announced the resignation of Dr. Ihrig as vice president and director of laboratories of the Globe Steel Tubes Company. During his 17 years with Globe Steel, Ihrig made many outstanding contributions to the steel tubes industry. In the past two years, he has served as a consultant for Allis-Chalmers in connection with its work for the Atomic Energy Commission.

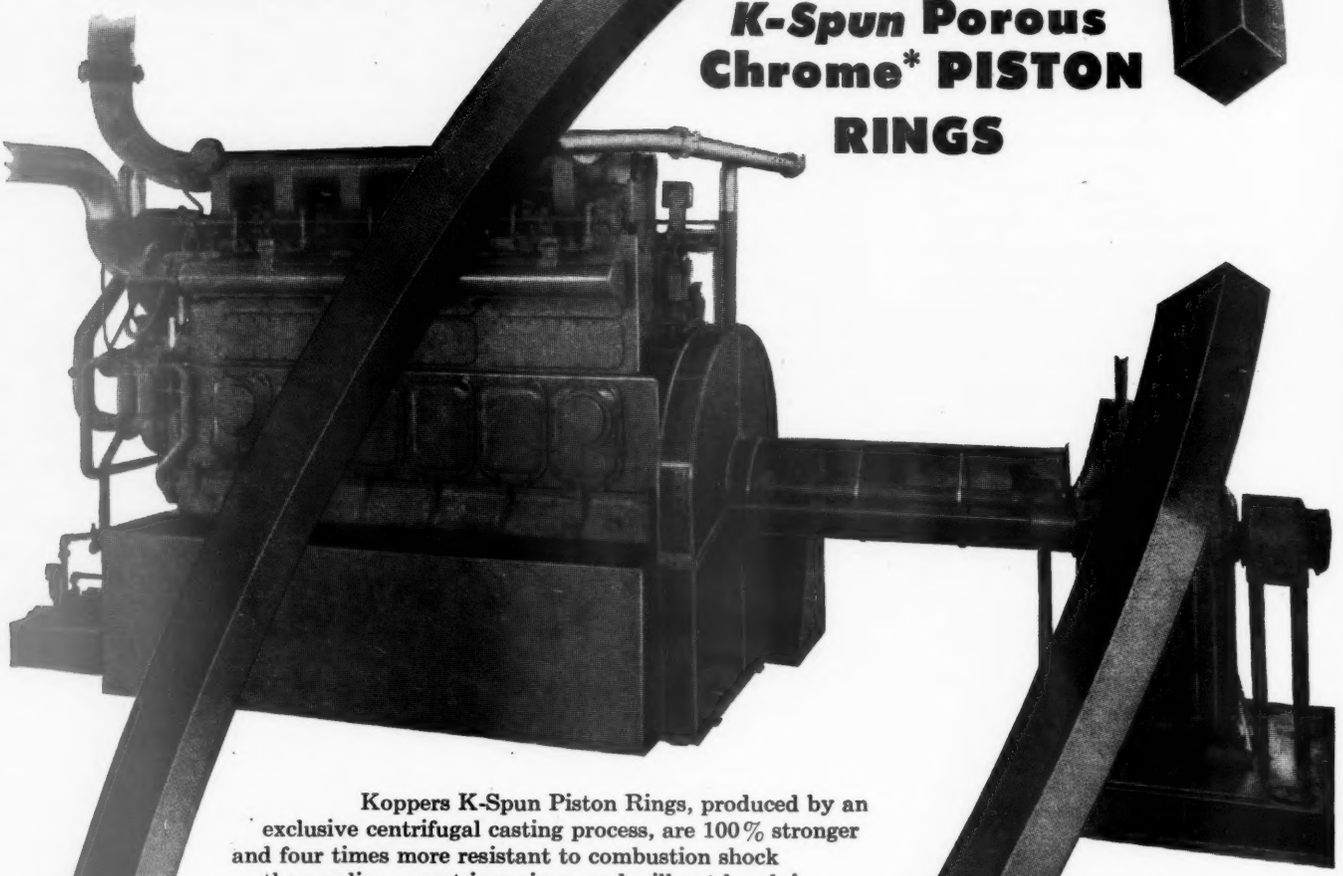
▸ **Delbert Kay** has resigned his position as advertising manager at Nordberg Manufacturing Company, Milwaukee, Wisconsin under a company retirement plan. Kay, who had been with the company 27 years, was in charge of advertising for all company product divisions. Advertising duties performed by Kay have been assumed by **J. D. Grace,** manager, advertising and sales development department.

▸ **John Wahlstrand,** Pacific Pumps Inc., manufacturers of centrifugal pumps, was appointed sales engineer with headquarters in the Houston, Texas, office of the company. He has resided in Houston since 1943 and is an associate member of the Houston Engineers' Club. He is well known throughout the petroleum, chemical, and other industries in Texas, Louisiana, Mississippi, and Alabama.

Oil Center Tool Company's Annual Sales Meeting. O-C-T sales representatives from Louisiana, Oklahoma, and Texas attending the annual meeting are: Standing, C. T. Jones, C. L. Braswell, R. L. Gammill, C. R. Sinclair, R. L. Cloninger, A. C. West, Jr., C. B. Wright, Jr., J. A. Clay, Ira C. Wells, M. E. Hunter, E. G. Amundsen, H. C. Stewart, A. M. Taylor, J. C. Norton, M. Davenport, and T. J. Dacy; seated, G. U. Berg, Jr., W. L. Wilcox, F. Richard, R. E. Galloup, J. E. Edwards, Walter Burke, and F. T. Smith. The meeting was held in Houston, Texas.

UNION OIL COMPANY
cuts cylinder wear, lengthens service of equipment with...

...KOPPERS *K-Spun* Porous Chrome* PISTON RINGS



Koppers K-Spun Piston Rings, produced by an exclusive centrifugal casting process, are 100% stronger and four times more resistant to combustion shock than ordinary cast iron rings, and will not break in installation or in service.

Koppers Porous Chrome Rings have a porous chrome surface that holds and distributes oil during break-in, quickly wears down to perfectly seated solid chrome that prevents grit and other particles from embedding in the ring surface where they can scratch cylinder walls. Porous Chrome Rings last up to four times as long as other rings, reduce cylinder wear 50% or more.

That's why hundreds of companies like Union Oil are reporting amazing savings in equipment and maintenance costs through the use of Koppers Rings. Remember . . . we make rings for *anything* that uses piston rings.

If you have a piston ring problem, why not get the *right* answer from us? Write, wire or phone KOPPERS CO., INC., *Piston Ring Dept.*, 1591 Hamburg St., Baltimore 3, Maryland.

Union Oil Company's newly modernized Avila (California) Terminal utilizes three 460 h.p. Enterprise dual-fuel engines with single-stage Ingersoll-Rand SHV centrifugal pumps. Engines are 6 cylinder, 12" bore, 15" stroke, 4 cycle, 450 rpm, non-supercharged. Each piston is fitted with two Porous Chrome, three tapered and two oilcutter Koppers Piston Rings.

KOPPERS

KOPPERS
AMERICAN HAMMERED
PISTON RINGS

*VAN DER HORST PROCESS

ONLY KOPPERS CAN FURNISH K-SPUN OR POROUS CHROME!

Carroll R. Baker has been appointed to the post of sales manager for all Red Devil oil field specialties, expendable parts for slush pumps, and pump maintenance tools, Oil Well Manufacturing Corporation, Los Angeles, California. A graduate of Cal Tech, Baker has for 14 years served in several capacities for Oil Well Supply Company. In Texas and Louisiana, he was a field engineer. During the war, he was moved to Oil City as an expeditor on war contracts.

P. B. "Pete" Erwin has been appointed district manager of the Los Angeles, California, branch office of Enterprise Engine and Machinery Company. Long identified with the Southern California oil industry, Erwin served with Bethlehem Supply Company of California for 12 years, where he was manager of machinery sales. Prior to that he was with Union Oil Company in the Los Angeles area as superintendent of power maintenance. In his new capacity as district manager with Enterprise, Erwin's primary activities will be in oil field, pipe line, and stationary engine sales.

P. B. Erwin

Arthur H. Lauder has been appointed manager of engineering of General Electric's large motor and generator divisions at Schenectady, New York. He succeeds the late **Earle S. Henningsen,** who died recently after 38 years' service with the company. Lauder was graduated from the University of Wyoming in 1922 and came to G.E. late that year as a student engineer on the company's test course. He joined the large motor and generator divisions in 1923, and was made assistant manager in 1948.

W. F. Weimer A. C. Daugherty

W. F. Weimer has been named advertising manager of the Rockwell Manufacturing Company of Pittsburgh, Pennsylvania. He succeeds **William A. Marsteller,** who has resigned as vice president of Rockwell to establish The Marsteller Company, marketing and advertising consultants, to be situated in Chicago. Weimer has been associated with the Rockwell organization for more than a decade in the gas products sales department, as editor of employee publications, and, for the past several years, as advertising manager of the Pittsburgh equitable meter division. **A. C. Daugherty** has been appointed manager of market research for Rockwell. He joined the company as a student engineer upon graduation from Penn State. In 1947 he became a market analyst in the company's market research department.

Max Campbell has been named vice president and general sales manager of the Security Engineering Company, Whittier, California. Campbell has been actively connected with the oil industry and with the sale of oil field equipment since his graduation from Rice Institute in 1938. He received his field training in Texas with the Hughes Tool Company in the sales department.

Max Campbell

Low cost FIELD HOUSING WITH FINE HOME CONSTRUCTION

MANUFACTURERS OF SPECIAL MILLWORK, DISTRIBUTORS OF JOHNS-MANVILLE BUILDING MATERIALS; CURTIS WOODWORK

STURDYBILT Houses are designed with the occupants in mind. That's why they are beautiful in appearance, conveniently arranged, and built with high quality materials. Their fine home look pleases oil field families, and their comparatively low cost appeals to companies that must supply field housing for their workers.

Write for information on all types of STURDYBILT Buildings for the oil fields.

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Prefabricated, Demountable Houses

phmi PREFABRICATED HOME MANUFACTURERS INSTITUTE

STURDYBILT HOUSES COMPLY WITH COMMERCIAL STANDARD CS125-45 OF THE NATIONAL BUREAU OF STANDARDS FOR PREFABRICATED HOMES

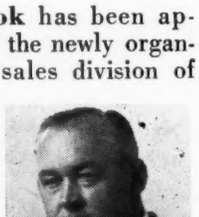
J. L. Myers

W. W. Wilson

Jim L. Myers and **W. W. (Bill) Wilson** have joined the sales department of The Western Company, Midland, Texas. Myers was with Continental Oil Company at Pampa, Texas for 6 years before leaving that company to go into the wholesale and retail gasoline business in that city. Wilson was an oil scout for Sinclair Oil and Gas Company for 4 years and was president of the New Mexico Oil Scouts Association for one year.

M. B. Garber has assumed the position of director of sales for The Thew Shovel Company, Lorain, Ohio. Garber announces the appointment of **J. T. Cushing** as sales manager, in complete charge of all domestic sales except those to the Federal Government. **Robert Maynard** remains in his present position as export manager. **Q. J. Winsor** relinquishes his present duties as assistant general manager and assumes a new position under the general manager with the title of manager of development sales.

Robert M. Cook has been appointed manager of the newly organized Strata-Crete sales division of Great Lakes Carbon Corporation. This announcement, made by Henry L. Walker, Jr., executive vice president, is to be effective immediately. Cook was previously vice president and general sales manager of Security Engineering Company and before that vice president and general manager of International Cementers.



R. M. Cook

Leo G. Sands has been appointed staff assistant of Bendix Aviation Corporation, Bendix radio communications division. He will handle advertising, sales promotion, and public relations, and will make his headquarters in Baltimore, Maryland. This marks a return to Bendix by Sands, who has been associated with Philco Corporation for the past 20 months, where he was very active in Philco's entry into the microwave radio field.

John P. Collier has been named vice president and sales manager, Panhandle Steel Products Company, Wichita Falls, Texas, succeeding **Thomas J. Lawless, Jr.**, and **A. B. Phillips** is chief engineer, succeeding **J. G. Brown.** Other company officials as announced by John V. Boyce, president, are: **R. C. Stanford,** vice president; **F. L. Durham,** treasurer; **Harry L. Holt,** plant auditor and purchasing agent; **W. G. Hilley,** assistant to the president, and **C. C. Hughes,** plant superintendent.

E. W. "Red" Lawlor, sales-service representative of Pittsburgh Coke and Chemical Company, has been transferred from the Pittsburgh, Pennsylvania home office to the Tulsa, Oklahoma office of the company's protective coatings division. In his new location, he will assist **Frank McNulty,** Tulsa manager, in serving the corrosion-protection needs of the Central West. Lawlor has been associated with the coal tar products industry almost exclusively since his graduation from Pratt Institute in 1941.

E. W. Lawlor

J. N. Forker, vice president and general manager of the tar products division, Koppers Company, Inc., since 1946, has retired and **Fred C. Foy,** who has headed the Koppers sales department, will succeed him. Foy has been elected a vice president of Koppers and has been relieved as manager of the sales department in order to assume the division general managership. **Cooke Bausman, Jr.,** who has been assistant to Foy, has been appointed acting manager of the sales department.

Forker is retiring after 35 years with Koppers.

T. R. McElhatten has been appointed sales representative for spudders in the Eastern oil fields, Bucyrus-Erie Company, South Milwaukee, Wisconsin. McElhatten will be attached to the Evansville sales district under the direction of **C. Earle Stewart,** district representative, well drill sales. To his new position, McElhatten brings a background of experience in the Mid-Continent and Eastern oil fields.

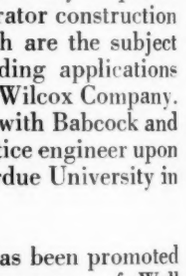
T. R. McElhatten

C. O. Relephord has been appointed to the position of Los Angeles branch manager for the pump division, Byron Jackson Company. The Los Angeles territory will cover several western states, Mexico, and the Far East. Relephord was graduated from the University of Oklahoma in June, 1932, with a B.S. degree in petroleum engineering, refinery option. After graduation, he was employed in a sales engineering capacity, dealing with technical equipment and applications for the oil industry throughout the Mid-Continent area. He joined Byron Jackson in 1946.

C. O. Relephord

Charles Henry Woolley, 44, assistant manager of the proposition department of The Babcock and Wilcox Company, New York, died suddenly on November 11 in Cranford, New Jersey. Woolley, who was well known in the field of power boilers, was the inventor of many improvements in steam generator construction and operation, which are the subject of patents and pending applications of The Babcock and Wilcox Company. He began his career with Babcock and Wilcox as an apprentice engineer upon graduation from Purdue University in 1927.

John W. Gates has been promoted to assistant sales manager of Well Equipment Manufacturing Corporation. Gates joined Well Equipment as shop foreman in 1946 after 4 years with the Navy during World War II. For the past 2 years he has been a division manager and prior to that time was Gulf Coast representative.



J. W. Gates

Ivor K. Thomas has been appointed division credit manager of The National Supply Company, Limited, oilfield division, the company has announced. His activities will cover the provinces of Alberta, Saskatchewan, and British Columbia and he will make his headquarters at Calgary, Alberta. Thomas joined National Supply in 1944 as a credit clerk in the company's Pittsburgh office. In 1946 he was transferred to Olney, Illinois as field credit representative and came to Canada in 1949 as district credit manager at Calgary.

Gordon Steinhoff has been named manager of the aircraft division of General Controls, leading manufacturer of automatic pressure, temperature, level and flow controls. An engineering graduate of Oklahoma University, Steinhoff, the new division head, has had wide experience in the field of sales engineering. Steinhoff will assist the branch offices in the 23 locations throughout the nation.

Gordon Steinhoff

H. G. Engel, manager of The Four Wheel Drive Auto Company's Western Sales Zone, has been appointed as office sales manager and the appointment of **V. M. Anderson,** district sales supervisor in Northern Illinois, to the vacated zone managership. Engel brings 27 years of experience in selling FWD trucks to his new position. He joined FWD in 1922. Anderson joined FWD as a service man in 1936 and was soon made manager of the service repair department. Transferred to the sales division, he was appointed district sales supervisor with headquarters in Salt Lake City, Utah.

Robert K. Spofford has been named director of purchases for John A. Roebling's Sons Company, Trenton, New Jersey. In his new position, Spofford will be in charge of the procurement of materials used in the manufacture of wire rope, electrical wire and cable, woven wire fabrics, cold-rolled steel, and related products. For the past 7 years, Spofford was associated with The Okonite Company, five of which he served as purchasing agent.

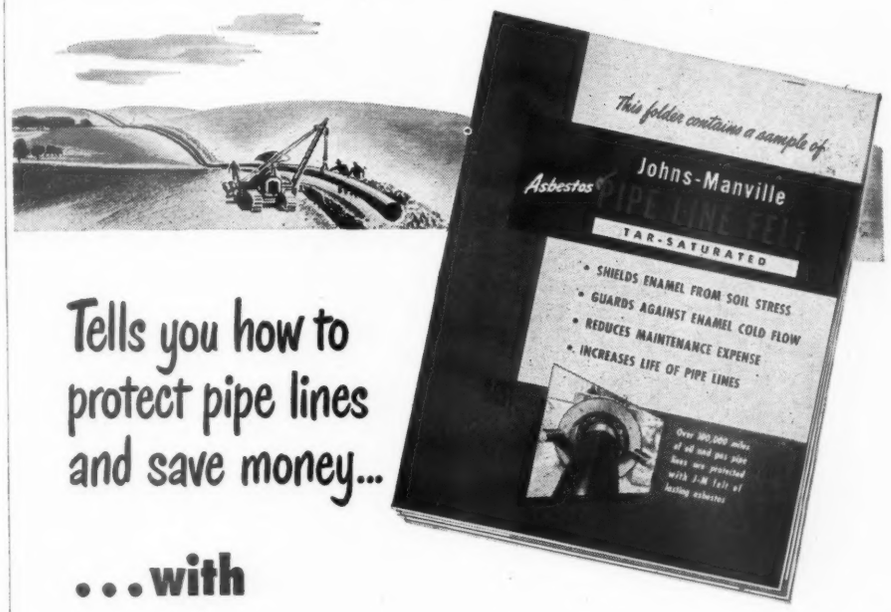
R. K. Spofford

J. William Geisler has recently joined the Pittsburgh staff of Fisher Scientific Company as petroleum apparatus engineer. He will advise on related matters of engineering, manufacture, and distribution. These instruments are distributed under the registered trade name of "Fisher-Tag." Geisler has over 13 years of experience in the petroleum field. Formerly he was associated with the Bureau of Mines, Bruceton, Pennsylvania, and Army Ordinance Department, Gulf Oil Corporation, and Duquesne Light Company, of Pittsburgh, Pennsylvania.

Joseph A. Conlon, formerly district sales manager, Chicago, Illinois, has been appointed manager of allied sales for the mechanical goods division, United States Rubber Company. At the same time, **Edwin D. Meade,** formerly manager of Western railway sales, was appointed district sales manager, Chicago, replacing Conlon. With headquarters in Rockefeller Center, New York, Conlon will be responsible for sales and merchandising activities of Eureka fire hose division, L. H. Gilmer division, New York Belting and Packing, and the card clothing sales division. Meade joined U. S. Rubber as a clerk in 1935.

Otto A. Bossart has been appointed sales and engineering representative for the contract products division of the Young Radiator Company. He is a graduate of the University of Wisconsin with a BS degree in mechanical engineering. He has been a member of the Milwaukee Chapter of the Society of Automotive Engineers since 1941. He has had long experience in the radiator business.

Otto A. Bossart



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...with

Johns-Manville Asbestos Pipe Line Felts

This new folder tells about Johns-Manville Asbestos Pipe Line Felt . . . the *only* type of underground pipe wrapping with a half century record of service in all kinds of soil. J-M Asbestos Pipe Line Felt now helps protect over 100,000 miles of oil and gas lines against corrosion.

Money-saving J-M Asbestos Felt guards against enamel cold flow, reduces maintenance expense, increases the life of the pipe line itself. The reason . . . because it gives much more protection than just a thin "reinforcement" of the enamel.

The mass and body of J-M Asbestos Pipe Line Felt will protect enamel against soil stress due to expansion and contraction caused by alternate wetting and drying of the backfill. J-M Asbestos Pipe Line Felt resists the destructive action of bacteria and fungi . . . will not rot or decay.

Whether for field application or mill wrapping, J-M Asbestos Pipe Line Felt is an excellent investment. For further information, including coverage data and a sample of the felt, send for a copy of this folder.

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Asbestos
PIPE LINE FELTS

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PE-11

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Box 290, New York 16, N. Y.
Please send me a copy of the sample folder of J-M Asbestos Pipe Line Felt, PP-22A.

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NOTICE: Visco Products Company is authorized to manufacture and sell Visco Oil Treating Compounds for use in the breaking and resolving of oil emulsions, or to grant licenses for such use, under the following United States Letters Patent: 2,050,639; 2,050,640; 2,206,589; 2,214,783; 2,214,784; 2,225,189; 2,303,414; 2,307,813; 2,318,034; 2,318,035; 2,321,056; 2,335,554; 2,454,808; 2,514,399. Visco Products Company is willing to grant licenses on a royalty basis, to oil companies, and to others desiring to practice the patented subject matter, under any and all of the above Letters Patent, permitting the user to purchase the oil treating compounds at will from any vendor, or to prepare the compounds for use or to use the compounds under the above Letters Patent. Application for license should be made to: **Visco Products Company,** Houston, Texas.

Machinery and Equipment

New! Improved! Needed!

(1) Boring Machine

A one-unit boring machine, which is claimed to provide a modern, economical, fast method of drilling holes under roadways, railroads, streets or any location not reached from the surface, is now being featured by Riley Machine Works, Burkburnett, Texas. The machine is compact, perfectly balanced, fully enclosed for safety and protection and can be lifted by its bail into or out of a ditch or trench. Dimensions are 7 ft by 24 in. thus making it possible to transport the machine in a small truck.

(2) Oil Field Tractor

Walter Motor Truck Company, Ridgewood 27, New York has developed a new oil field tractor, Model FZMA, to offer compact, fast, highly

mobile carrier for oil field well servicing equipment. On normal roadways this unit can roll at speeds of from 30 to 40 miles per hour. Due to the high tractive effort, this unit can be effectively used to haul trailers and other equipment. It develops a tractive effort of over 12,000 lb at 3 miles per hour. Total weight is approximately 16,000 lb.

(3) Power Drives

New electric remote control for Sterling Speed-Trol (variable speed) electric power drives is announced by Sterling Electric Motors, Inc., Los Angeles 22, California. This is a package unit design, which may be mounted on any size Speed-Trol of current design by the user in the field as well as being available with new Speed-Trols at the factory. The package unit includes a mounting bracket, reversing motor, chain and sprockets, friction clutch, chain guard, and remote "Fast-Slow" station. It is available either with or without an electric remote speed indicator, and the electric remote speed indicator is a companion unit that has likewise been developed to mount on any Speed-Trol by any mechanic. Speed-Trol power drives are available in ratings of ½ hp to 25 hp, with a speed variation of 2:1, 3:1, or 4:1.

(4) Water Softener

Elgin Softener Corporation, Elgin, Illinois, has announced a single tank deionizer that gives water of higher quality than that produced by 2 and 4-column deionizers. In addition to producing high quality, mineral-free water, the manufacturer claims this deionizer will also completely remove silica and CO_2 from water. Using single-tank rather than multiple-tank equipment, the investment cost for this new type deionizer is considerably lower and rinse requirements are reduced. An important feature of this equipment is its "double-check" manifold arrangement, which guards against loss of zeolite during the backwashing operation and permits the use of deeper zeolite beds for increased capacity. When resinous zeolites are used, prevention of zeolite loss by means of this type manifold is especially important.

These are very brief descriptions of new items manufacturers have put on the market but you need more information to appreciate advance in design, materials, performance, etc. Send the coupon below for details.

Get Full Details of January, 1951, Listing—Circle Figures and Mail Coupon to

THE PETROLEUM ENGINEER

P. O. Box 1589, Dallas, Texas

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
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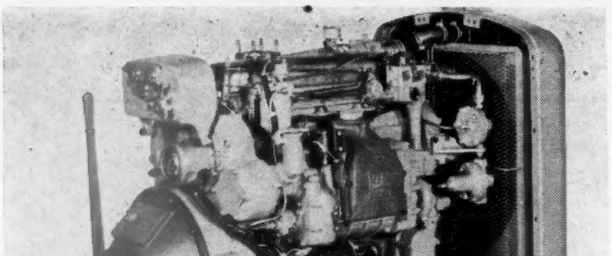
51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66		

NAME ..... TITLE .....

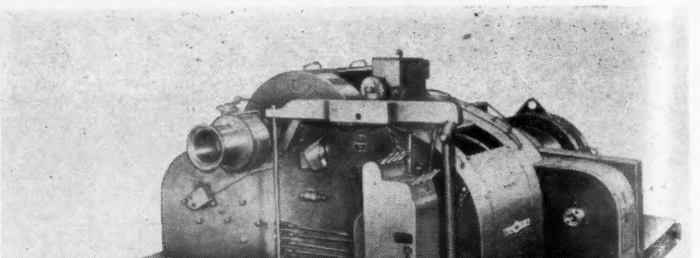
COMPANY NAME .....

STREET ADDRESS .....

CITY ..... ZONE NO. ..... STATE .....



Series 71 diesel engines.



National Supply's drilling rig.

hydraulically
BALANCED SEAL
Actual light hydrocarbon installation illustrates application of the John Crane balanced seal.

Seals propane and other light hydrocarbons

"Service-Proven" on Refinery and Pipe Line Installations

The "John Crane" Type 1 Shaft Seal will mean outstanding sealing performance on practically all your petroleum services, *including the effective sealing of Butane, Propane and other light hydrocarbons.*

This seal is being widely used today for all general petroleum services—is suitable even for pressures to 500 psi.

It is a single unit and requires no auxiliary lubricating system. Proper balancing of sealing faces, and the selection of proper face widths for each job insure leak-proof operation.

Based on our wide refinery and oil field experience, we usually recommend the single balanced seal, as shown above, with perfect mating faces and with enough flexibility to allow plenty of axial and radial movement. Numerous installations have shown that any pump in good working order, using reasonably clean fluid, can be successfully equipped with this seal.

Proof of its unequaled service is found in its use by many major refineries. Practically all leading pump manufacturers, too, agree that this seal is the best means for sealing hydrocarbons. Most manufacturers furnish it as standard equipment.

Stocks of seals and packings are carried in our offices listed below. Our engineers in 32 branches are on hand to look after your service requirements.

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CRANE PACKING COMPANY

Houston 6626 Supply Row Houston 11, Texas
Chicago 1843 Cuyler Ave. Chicago 13, Ill.
Los Angeles 140 North Marine Ave. Wilmington, Calif.

Offices in All Principal Cities in United States and Canada

(5) Dual-Fuel Engine

The Detroit Diesel Engine Division of General Motors, Detroit, Michigan, has announced a new option on Series 71 diesel engines, which enables them to burn natural gas in accordance with true diesel high-compression principles. This option is available both on new engines leaving the factory and engines already in use. For the latter a factory-engineered kit is available for the changeover. The changeover permits the engines to burn either natural gas with a pilot charge of diesel fuel or diesel fuel alone.

(6) Drilling Rig

A new drilling rig for medium depths is announced by The National Supply Company. This rig, known as the Ideal Type 75-CA consolidated rig, is designed for 650 input horsepower and is normally considered for drilling in the 6500-to-9500-ft depth range. The new rig supersedes the Type 75 rig. New features and improvements include (1) Ideal Dy-A-Flex air clutch for the high drum drive, (2) air-operated Twin Disc Model "P" air clutch for rotary drive, (3) separate, centralized control cabinet for air operation of the rig, (4) 1½-in. pitch quadruple engine-to-drawworks drive chain.

(7) Bulldozers

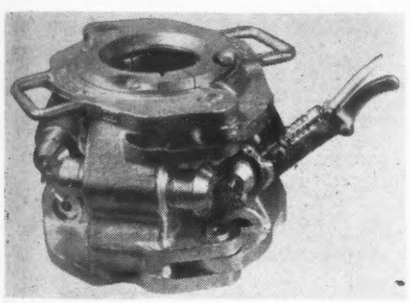
New bulldozers, gradebuilders, and root rippers, for the new and more powerful models HD-9 and HD-15 Allis-Chalmers Tractors, are announced by The Baker Manufacturing Company of Springfield, Illinois. The implements round out a complete line of matched earthmoving equipment for A-C tractors, Baker having previously announced new blades for the largest and most powerful unit, the HD-20 and the smallest, the HD-5. Both engine-mounted hydraulic and cable operated models are available for the three larger tractors.

(8) Blow-Off Valve

Everlasting Valve Company, Jersey City, New Jersey, announces the addition of a Straightway "Y" type valve to its line of boiler blow-off valves. Built in strict conformance to the ASME Boiler Code, this valve has many distinctive features, the company asserts. The head, or disc, is made of "H" monel metal and the seat of monel metal. This combination of metals has proved, through the years, to be ideally suited to withstand the erosive and corrosive conditions to which a slow opening blow-off valve is subjected. The seat, which is renewable is provided with upper and lower sealing gaskets, the stem is made of stainless steel, and the stem nut is made of bronze.

(9) Tubing Spider

Kinzbach Tool Company, Houston Texas has developed a new automatic tubing spider, which employs parallel-operating linkage for gripping and suspending the tubing instead of conventional conical wedges. A single lever control actuates all segments simultaneously and in proper relation. Then the operator may reach the elevators while operating the spider with one hand. The action is accomplished by the use of bevel-gear quadrants connecting the ends of the cam



shafts. The control lever is attached to one of these gears. An indexing pin, operated by a squeeze grip on the control lever, permits locking the segments positively in engaged or disengaged position. By the use of parallel cams as load connectors between the segments and the spider body, it is possible to hold all segments in alignment with the tubing and to maintain a gripping force that is accurately proportional to the load.

(10) 1951 Trucks

Ford division, Ford Motor Company, has introduced new Ford trucks for 1951, including more than 180 models designed to reduce operating costs, make trucks adaptable to more jobs and to add driver convenience and comfort. L. D. Crusoe, vice president and general manager, Ford, announced scores of engineering, styling, and safety improvements covering the 4 Ford truck engines, chassis changes, and introduction of a new "5-Star Extra" cab. New Ford trucks feature automatic power pilot carburetion-ignition control on all engines. The rear window was redesigned and enlarged to more than three and one half feet for full range vision. The standard three-speed transmission for the F-1 has been redesigned for more rugged loads and longer wear. It has constant mesh helical gears with synchronizers in second and third speeds. A new panel incorporates full-vision and rheostat type instruments.

(11) Portable Seismograph

Technical Instrument Company, Houston, Texas, announces a new model 25 trace unitized portable seismograph, complete with 24 amplifiers, housed in one water-tight stainless steel case weighing 55 lb. Amplifiers are high gain AVC or expander type with individual gain controls, filter switches, high line eliminators and a built-in cable tester is provided on each amplifier channel. Other features include automatic trip circuit, accurate timing check, plug-in amplifier, excellent optical system. Hinged construction allows long panel wear.

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HAERING ORGANIC GLUCOSATES*
have an unexcelled record
of performance in controlling
SCALE, CORROSION AND ALGAE
in the
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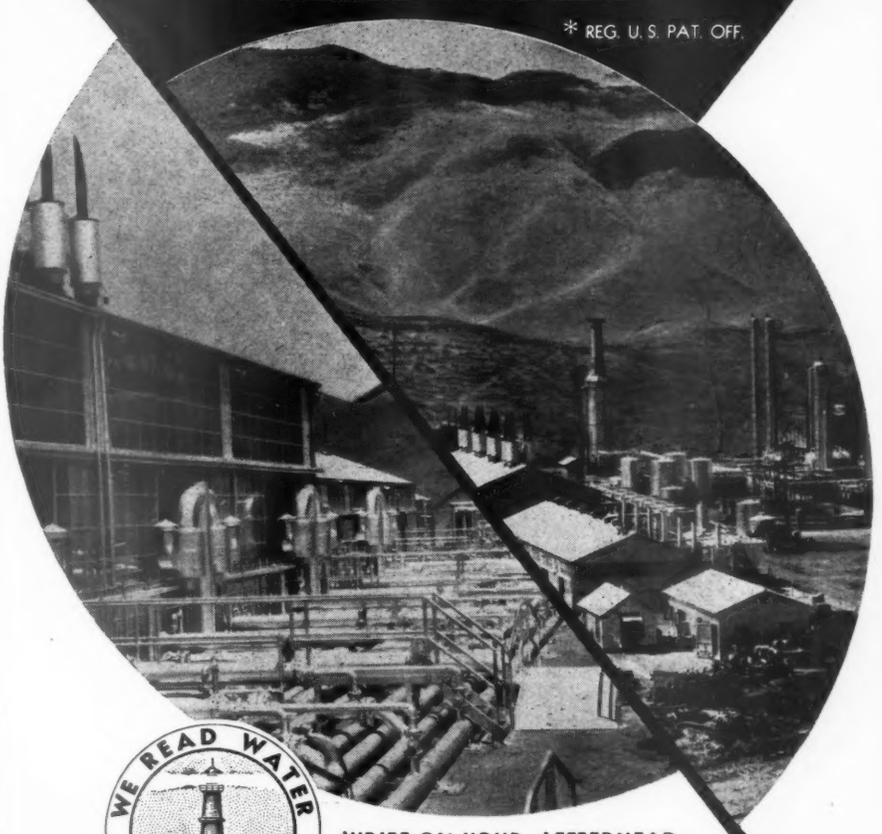

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FOR SPECIAL LITERATURE

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9,500 feet electric conducting cable. New, never used, prestressed and preformed. 48,000 lbs. breaking strength. 2507 Mercantile Bank Bldg., Dallas, Texas.

FOR SALE

1 electric magnetic fishing tool outfit, with magnets capable of lifting 1,000 lbs. Adaptable for fishing junk like drilling cones and such out of oil wells. 2507 Mercantile Bank Bldg., Dallas, Texas.

MECHANICAL ENGINEER

New large oil pipeline company requires mechanical engineer to handle design, supervise construction, and devise maintenance procedures on all pump station equipment to 5,000 HP, not including electric equipment. Station specifically includes 2,000 HP maximum IC engines and centrifugal pumps. Complete familiarity with high pressure oil piping required. Men under 35 preferred. Include full professional details and minimum salary first letter. Write Box 121, care The Petroleum Engineer, P. O. Box 1589, Dallas, Texas.

FOR SALE

One completely rebuilt LP-600 Cummins Diesel Power Unit; new block, pistons, liners, camshaft, bearings, crankshaft .010 under, radiator, B-218 Twin Disc Clutch and Air Starting equipment; warranted, very reasonable price.

One Model LI-600 Cummins Diesel Engine, completely rebuilt, for sale either as Power Unit or as 100 KW Generator Set, V-belted to 1200 RPM General Electric Generator with switchboard.

One Model LI-600 Cummins Diesel Engine, completely rebuilt, 720 RPM, on common steel base, direct-connected to General Electric Generator, serial No. 5432799, Type ATI, frame No. 7632, 480-volt, 3-phase, 60-cycle, 125 KVA, 80% power factor, 100 KW, with 125-volt exciter, 22.5 amp. For further information, write Valley Land & Warehouse Company, Inc., 502 Weatherly Building, Portland 14, Oregon.

(12) Lining Service

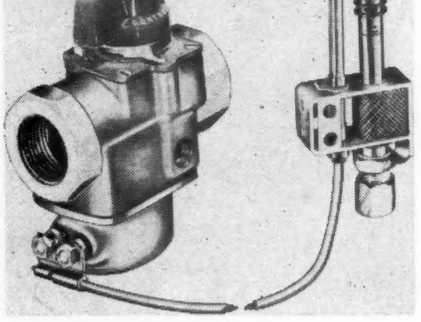
A cement-mortar lining service for old, small diameter pipe lines, that gives new pipe line performance at a fraction of new pipe line costs, is announced by Pipe Linings, Inc., newly formed subsidiary of American Pipe and Construction Company, Terminal Annex, Los Angeles, California. Licensed for nation-wide operations under Tate pipe lining patents, the new company has complete facilities for servicing water, gas, and oil pipe lines of 4-in. diameter and larger, according to Robert C. Sargent, Manager. The Centriline Corporation, New York 6, New York, has been licensed to handle service in the eastern part of the United States.

(13) Fire Killer

A new fire killer for extinguishing flammable liquid and electrical type industrial fires has just been announced by American - La - France - Foamite Corporation of Elmira, New York. It is the new Alfco 350 dry chemical wheeled portable engine, the largest unit of this kind now available, yet one which can be easily handled by two men. The tank of the engine contains 350 pounds of Alfco dry chemical. The entire contents can be discharged if necessary in about one minute and 15 seconds. Expellent is dry nitrogen, with a sustained operating pressure of 200 psi during the entire period of discharge.

(14) Safety Valve

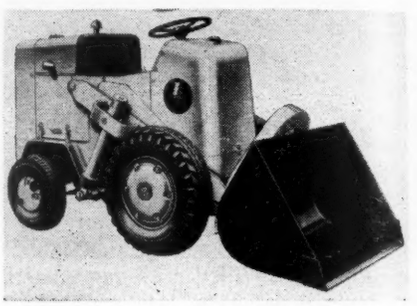
Two new General Controls products, a new MR-5, ¾ in. gas cock safety valve and the 260 Series pilot burner



have been announced by General Controls Company, Glendale, California. The new products are both precision-made to accommodate the requirements of adequate heating control, the company stated, while providing the means for absolute safety and low fuel consumption. The new pilot burner is designed on a smaller scale than its predecessors. It incorporates a removable filter screen that assists in eliminating the nuisance of lint plugging.

(15) Tractor-Shovel

The Frank G. Hough Company, Libertyville, Illinois, announces production of its new, improved Model HA payloader. This small, compact 12



cu ft tractor-shovel has many uses in foundries, fertilizer plants, and processing and manufacturing plants where bulk materials must be unloaded from box cars and materials must be moved inside and outside of buildings. The new improved Model HA is a faster, more rugged, and more powerful machine than the old one. A new higher compression engine gives more power and economy; the clutch is larger; operators compartment is roomier and more comfortable, and the steering gear and linkage is more rugged.

ENGINEERS

Major oil company operating in the Middle East requires graduate engineers in the following classifications:

SENIOR PROCESS ENGINEER
GEOPHYSICS ENGINEER
GEOLOGIST (SEISMOGRAPH)
ASST. GEOLOGIST (SUBSURFACE)
ASST. CHEMICAL ENGINEERS
ASST. CHEMIST (ANALYTICAL)
GEOLOGICAL DRAFTSMAN

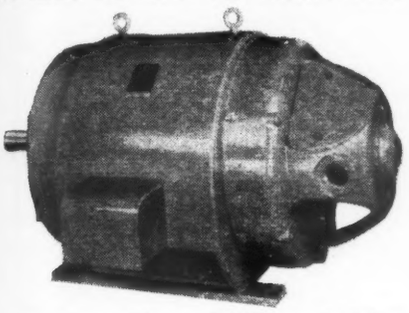
Also we have positions for experienced and inexperienced civil, mechanical, electrical, construction and highway engineers.

If interested, write giving full outline of personal and employment history.

Write Box 117, Care THE PETROLEUM ENGINEER, P. O. Box 1589, Dallas, Texas

(16) Wound-Rotor Motors

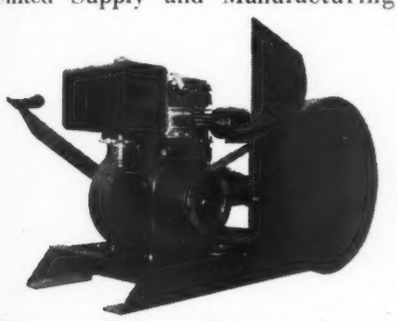
Electric Machinery Manufacturing Company of Minneapolis, Minnesota announces a new line of heavy-duty, wound-rotor induction motors. These



motors provide variable speed drive, and are also advantageous on applications requiring high starting torque and low starting current, or long acceleration periods. Built in ratings from 30 to 1500 hp, drip-proof construction is supplied on these motors.

(17) Engine Starter

A new engine starter for 5 hp to 90 hp engines has been announced by H. B. Gutelius, Jr., vice president of United Supply and Manufacturing



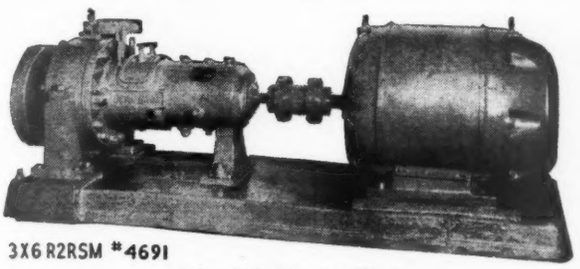
Company, Tulsa, Oklahoma. According to Gutelius, one of the main improvements of the new starter engine is the location of the pull rope on the outside of the starter . . . away from the engine. This gives the operator more freedom and enables him to handle the pull-rope with a greater degree of safety. When the starter engine is running, the operator, by pushing a foot pedal, engages or disengages a revolving rotor on the rim of the engine's fly wheel.

(18) Gas Alarm System

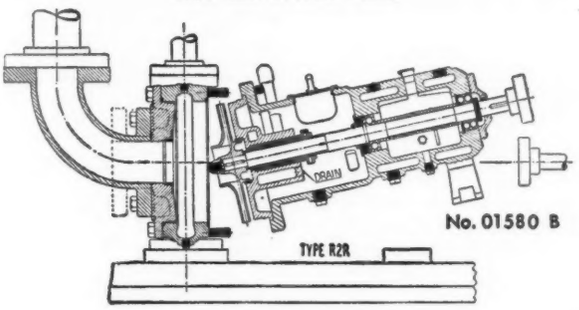
A continuous combustible gas alarm system incorporating a new principle of gas and vapor analysis and measurement is announced by Davis Instruments Division of Davis Emergency Equipment Company, Newark, New Jersey. The new type of analyzer was perfected after 4 years of research and development, and is produced by Davis under exclusive license. Zero drift, a major factor in the Wheatstone Bridge principle, has ben eliminated, and hence the new Davis gas

DEAN BROTHERS PUMPS INC.

Type R2R Centrifugal Process Pumps



Type R2R Process Pump



Type R2R Process Pump

DISASSEMBLY: The Type R2R process pumps can be disassembled without disconnecting the suction and discharge piping. By first removing the spacer from the spacer type coupling, and unbolting the casing from the cradle the entire cradle and complete rotating element can be removed without disturbing the suction and discharge piping.

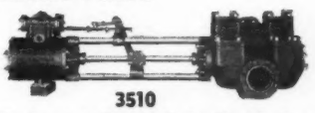
OPERATING RANGE; Type R2R, Heavy duty, process pumps are available in eighteen different sizes, enabling our engineers to furnish units specially designed and constructed for the particular work to be performed.

Capacities: 50 to 2000 Gallons per minute. Heads: Up to 400'. Speeds: 900 RPM to 4000 RPM.

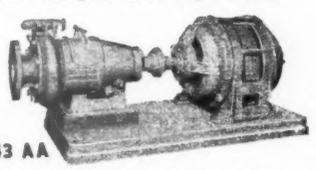
BUILDERS OF OUTSTANDING PUMPS SINCE 1869

CENTRIFUGAL and RECIPROCATING PUMPS

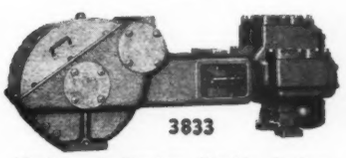
Close Coupled Centrifugal Pump



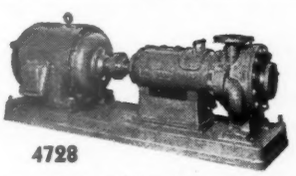
Horizontal, Single Style, Double Acting, Piston Type, Close Clearance Pump. Designed to handle volatile liquids



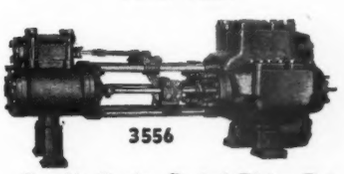
Pedestal Mounted Centrifugal Pump



Horizontal, Duplex, Double Acting, Side Pot, Piston Type, Oil Bath Power Pump



Double Pedestal Bearing Centrifugal Pump



Durable Duplex Packed Piston Pattern Steam Pump, Side Pot Type

ESTABLISHED 1869

DEAN BROTHERS PUMPS INC.

INDIANAPOLIS IND.

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What do you want in a pump?

Maximum Compactness
Johnston Vertical Pumps require as little as one-fifth the floor space of conventional type pumps of comparable capacity . . . a big saving wherever space is a factor!

Fool-Proof Operation
Johnston Vertical Pumps require no priming—a feature that not only eliminates complicated priming equipment, but also permits fully automatic operation from remote locations without risk of pump damage!

Highest Efficiency
Johnston offers all types of vertical pumps. If your problem requires water lubrication with either semi-open or closed impellers for highest efficiency—or oil lubrication with either type impeller—you can get the right combination from Johnston!

Trouble-Free Service
Dual bearings of rubber and bronze in the pump bowl assembly . . . Replaceable stainless steel sleeves on shafts at points of bearing contact . . . Triple XXX Seal between bowls and impellers . . . Johnston features that assure longer life and minimum maintenance.

Wide Adaptability
You can readily move a Johnston Vertical Pump from one job to another—even from such widely divergent jobs as deep-well water supply to close-coupled line pumping. This cuts pump investment to the bone!

JOHNSTON TURBINE PUMPS

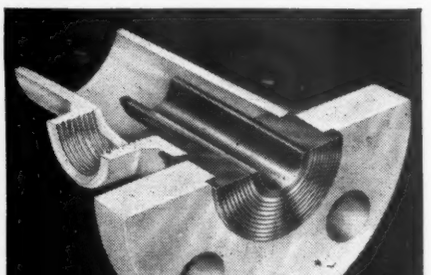
No matter what your pumping job, contact your nearby Johnston Dealer or write the factory direct about important savings that you can make by installing Johnston Vertical Pumps.

Johnston Pump Company
2324 East 49th Street
Los Angeles 58, California

alarm system can be used as a continuous detection and alarm system for protection of processes, plants, and personnel. The manufacturer claims it functions as a stable system insuring constant zero balance over holidays, without attention, and for process control.

(19) Heat Exchanger

A new design of heat exchanger announced by the Martin-Quaid Company, Philadelphia 32, Pennsylvania,



provides a number of unique features particularly adapted to present day process piping requirements. In the Econalloy design, corrosion resistant materials are used only where required: As flange inserts and for the inner tube that contacts the fluid or vapor being heated. An important feature is that a corrosion resistant joint is made without welding to the inner tube. The alloy inner tube is expanded into prepared serrations in the i.d. of the insert flange by special torque limit tools that prevent stresses.

(20) Speed Series

A new variable speed transmission series, incorporating the Worthington tandem belt design, has been developed by Worthington Pump and Machinery Corporation, Harrison, New Jersey. The new line, known as the Worthington Allspeed Drive, will consist of six models, rated at 1, 3, 5, 7½, 10, and 15 hp respectively and will offer variations of 16 to 1, 10 to 1, 9 to 1, 8 to 1, 6 to 1, and 6 to 1 respectively. At 1725 rpm input, the 1 hp unit offers a range of 215 to 3450 rpm and the 15 hp unit will vary from 370 to 2220 rpm with an input speed of 1750 rpm.

(21) Control Valves

Kieley and Mueller, North Bergen, New Jersey announces construction of what they believe to be the largest new double-ported control valves on the market. The valves have 36-in. pipe connections, open and close within one second, and provide tight shut-off.

SAND-BANUM
Pure Colloidal Concentrate
Is the
"Old Master"
in Saving Power Plant Dollars through the safe and certain Removal and Prevention of Boiler Scale.
Use Ounces Only Once a Week

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For ALL Radiator Cooling Systems—Use
SAND-BANUM SPECIAL
Pure Concentrated Tablets
Stocked by Leading Supply Houses
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Established 1926
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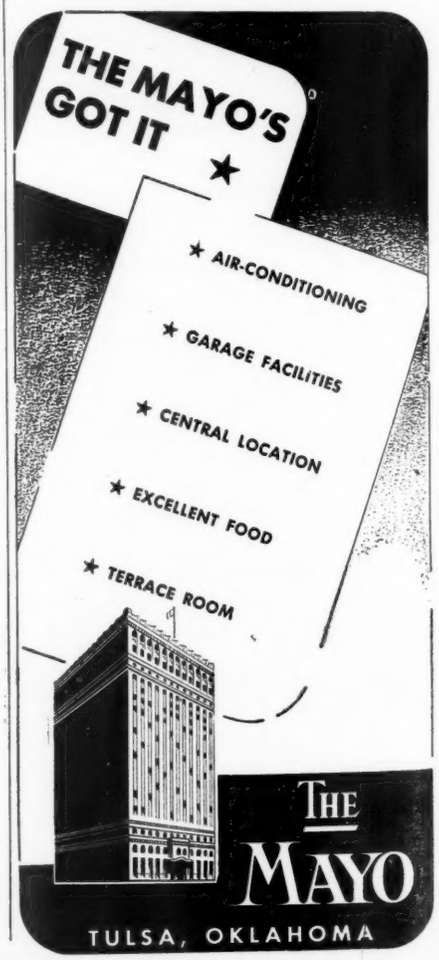
New York 20, N.Y.



Trade Literature

Publications will be sent free.
Circle the number on coupon.

(22) Molybdenum Bases

Four new types of lubricants employing molybdenum metal and derivatives as bases for lubricants have been announced by the lubricants division of The Lockrey Company, College Point, New York. These new products, discussed in Technical Bulletin No. 21-E are Liqui-Moly NV Regular and Grease, Liqui-Moly NV Thread Compound, and Moly-Wax-Stix. The molybdenum is suspended in a volatile liquid to carry it to the bearing where the liquid is evaporated and the solid lubricant incorporates itself with the bearing metal. Such lubricants may be employed on bearings running at read heat, such as in steel rolling at 2250 F without losing lubricating efficiency. Safe operating temperatures are extended "several hundred degrees," it is stated and permissible working pressures are doubled by using these new lubricants.

(23) Universal Joints

Just off the presses is the 1951 catalog C1, published by Curtis Universal Joint Company, Inc., Springfield 7, Massachusetts. Some of the highlights of this catalog are: How to select universal joints; accurate graphs on such subjects as, static torque tests in inch pounds, angle of operation efficiency curves, frictional heat loss curves; dynomometer tests; assembly and dis-assembly instructions; engineering data, weights, specifications, dimensions, and complete buying and ordering instructions, plus a price list.

(24) Diesel Engines

Baldwin Locomotive Works, Philadelphia, Pennsylvania, announces a new 4-page bulletin, No. 321, covering Series 600 diesel engines. These engines have a 12¾-in. bore, 15½-in. stroke, and a speed range from 360 to 625 rpm. They include both naturally aspirated and supercharged engines for stationary and marine service. The bulletin includes design features and specifications, performance curves, and ratings, which range from 430 to 1500 hp. Illustrations include cross sections, dimensional drawings, and rating charts.

(25) Motor-Generator Sets

A new 8-page, 2-color booklet on synchronous motor-generator sets has been announced as available from the General Electric Company, Schenectady 5, New York. Designated as GEA-5506, the publication covers motor-generator sets from 30 to 8000 kw as a source of d-c power for many industrial applications, such as rolling-mill motors and other drives, electrolytic refining of ores, excitation for synchronous and d-c motors and generators, motion picture lighting, mining and quarrying, wind tunnels, and other large testing equipments, and general purpose use. Well illustrated, the booklet shows four typical installations and describes the construction features of the synchronous motors and d-c generators.

(26) Wire Rope

John A. Roebling's Sons Company, Trenton 2, New Jersey, has published a catalog on wire rope for excavators. A new feature of this company's catalog, it reports, is a new section under the heading of "Recommendations." This section lists actual recommendations for specified usages and includes the wire rope code. Hoist ropes for excavators are fabricated of 6 strands and an independent wire rope core. The number and arrangement are determined by the rope size required. Tapered wire rope ends facilitate installation on excavating equipment. Either welded or soldered depending on rope size—welded up to 1½-in., sizes beyond that range are soldered —the tapered end provides the means for quick insertion through the drum hole, and facilitates pulling the rope through blocks and over sheaves, the company asserts.

(27) Pressuregraph

Electro Products Laboratories, Inc., Chicago, Illinois, has published a flyer describing the Electro pressuregraph and supplementary instruments for precision research on dynamic pressure and displacement phenomena. The Electro dynamic micrometer measures static or dynamic displacement due to eccentricity, axial vibration, radial whip, bearing clearance, radial expansion with acceleration and reciprocating movement. Measurements are independent of acceleration or speed of rotation and are made without any mechanical contact between sensing unit and moving object.

(28) Control Accessories

In the new condensed catalog, just released by Wheelco Instruments Company, Chicago, Illinois, a selection of typical Wheelco indicators, controllers, and combustion safeguards are illustrated and briefly described. An accompanying 4-page price list contains the listing, description, and current price applying to nearly all of the standard instruments manufactured by this company. Wheelco sales and service engineers and their addresses in the states and foreign countries are also listed.

(29) Steel Tubing

The Babcock and Wilcox Tube Company, Beaver Falls, Pennsylvania, offers a new technical data card on the chemical compositions of the company's seamless alloy steel tubing, specifically B & W Croloy steels of the low and intermediate alloy groups. These apply to pipe for high-temperature service and tubing for use in heat exchangers, condensers, refinery stills, boilers, and superheaters. Data covers carbon, manganese, phosphorous, sulphur, silicon, chromium and molybdenum content, according to ASTM specifications. In addition to the seamless steel tubing, the company manufactures seamless alloy steel tubing for mechanical applications and welded carbon steel tubing.

(30) Diesel Engine Design

A new 28-page booklet entitled, "Ten Questions to Ask a Diesel Engine Salesman" is being offered by the Murphy Diesel Company, Milwaukee 14, Wisconsin. The booklet asks and answers 10 questions pertaining to diesel engine design and gives full mechanical details on the Murphy diesel line of engines. Questions are concerned with the design features that make possible more power, greater fuel economy, and greater dependability, which the company claims are found in Murphy diesels.

(31) Mud Behavior

An instructive and well arranged brochure has just been issued by the Weyerhaeuser Timber Company, Longview, Washington, describing clearly the company's complete line of products for mud conditioning, well completion, and the prevention or reduction of circulation loss. The fundamental factors that affect mud condition and behavior are discussed in a simple but rational way, and just what is required to combat or control these factors is logically developed. The entire treatment will be found of great interest to mud engineers and others concerned with drilling fluids.

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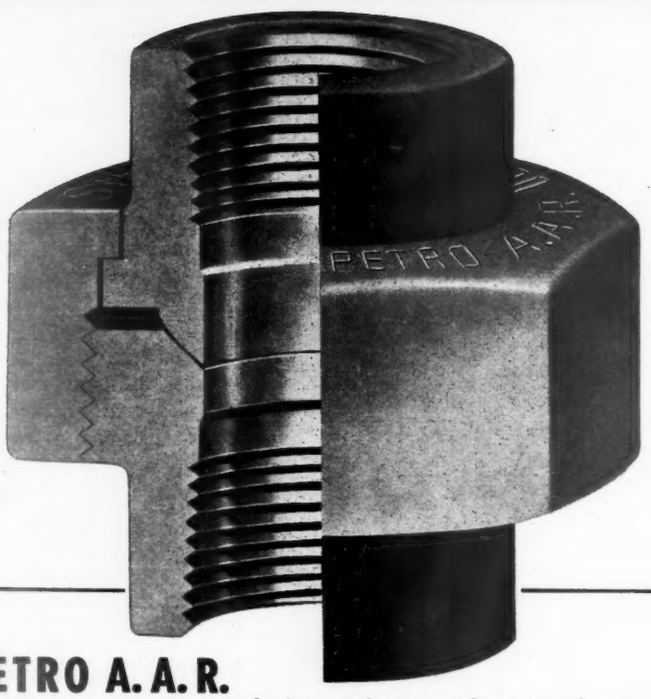

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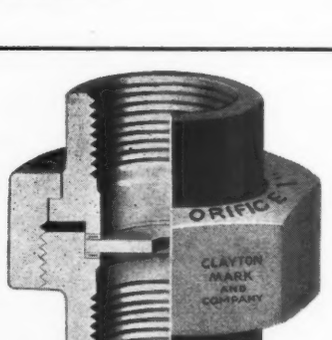

Write Dept. P for illustrated catalog or refer to listings in Composite Catalog pages 3140-3141, Refinery Catalog page 538, and Chemical Engineering Catalog pages 980-981.

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(32) Drilling Equipment

The Brewster Company, Inc., Shreveport, Louisiana has published a 36-page booklet portraying its matched drilling equipment in pictures and in words. Diagrams and charts also add to this concise and thorough bulletin. Brewster products include: Drawworks, wire line reels, service winches, rotaries, traveling blocks, hook blocks, crown blocks, swivels, well heads, tubing heads, and casing heads.

(33) Float Trap

A new catalog bulletin on float traps has been issued by the V. D. Anderson Company, Cleveland, Ohio. This folder gives complete specifications, capacities, pressures, sizes, and price lists of the three principle float traps manufactured by Anderson: Models "D", "F", and "Junior" traps. Anderson float traps are widely used to drain condensate from steam equipment as well as moisture from air and gas equipment. Detailed information is given on these applications. Cross sections of float traps, air release valves, strainers and Super-Silvertop steam traps are shown.

(34) Data Sheets

Dow Corning Corporation, Midland, Michigan has published a new series of data sheets describing its Silicone Dielectrics. They give the most recent data on DC 993 and DC 996, the silicone varnishes that introduced a new era in electrical insulation. These semi-inorganic materials, developed and produced by Dow Corning, permit maximum use of the heat-stability of fibrous glass, asbestos and mica. Standards for Class H insulation were based on the accelerated life-testing of DC 993-mica-glass insulated motors. A life-expectancy of at least 10 times the service life of Class B equipment was established by this test program.

(35) Pipe Line Equipment

M. J. Crose Manufacturing Company, Inc., Box 3368 Whittier Station, Tulsa, Oklahoma, has issued a new 70-page catalog on pipe line equipment, materials, and supplies. Illustrated is the specialized equipment manufactured by the company, such as pipe cleaning and priming machines, pipe coating and wrapping machines, tar heating kettles, Vitron glass wrapper, internal line - up clamps, beveling machines, and most other supplies and equipment needed in pipe line construction. Also included is a useful section of data on coating and wrapping materials, giving mileage and quantity data.

Books you may want

Bibliography of Pressure Hydrogenation, *by J. L. Wiley and H. C. Anderson, Bulletin 485, Bureau of Mines, Superintendent of Documents, U. S. Government Printing Office. Pages, 306. Price, $1.25.*

According to the introduction this review contains abstracts of the technical literature and patents dealing with the application of the Bergius and related processes for the hydrogenation of liquid or solid carbonaceous materials. An attempt has been made to include abstracts of all the published information on this process. The material is divided into two sections, literature and patents, and each of these is arranged alphabetically by author or patentee.

Economic Aspects of Atomic Power, *by Sam H. Schurr and Jacob Marschak. Princeton University Press, Princeton, New Jersey. Pages, 298. Price, $6.*

The authors have here concentrated on the potential uses of atomic power that seem the most remote: The generation of electricity from heat caused by nuclear reactors and transportation of low temperature heat over short distances, as for residential heating. They present an outline of the economic effects of atomic power on the economy of a highly industrialized country like the United States, and on the industrialization of so called backward areas. An economic comparison is made between electricity generated from atomic heat and that produced from coal, oil, or water power, for various areas of the world. The study was initiated by the Social and Economics Aspects of Atomic Energy of the Social Science Research Council and executed by the Cowles Commission for Research in Economics.

Reviews of Petroleum Technology, *(Volume 9). George Sell, editor. Published by The Institute of Petroleum 26, Portland Place, London, W. 1. Pages, 340. Price, 27s 6d.*

This volume follows the general line of its predecessors in the series and reviews, and the highlights of petroleum technology during the year 1947. It covers subjects from geology to legislation, in 25 chapters, each by an authority on the subject discussed. There are references to over 2000 technical articles and patent specifications.

Handbook of Chemistry and Physics, *32nd edition. Charles D. Hodgman, editor in chief, published by Chemical Rubber Publishing Company, 2310 Superior Avenue N.E., Cleveland, Ohio. Pages, 2897. Price, $7.50.*

The aim of this book is to present in condensed form reliable and up-to-date information in the fields of chemistry and physics for extensive use. The 32nd edition of the handbook contains 335 pages of completely revised and new material. Rapid development in the field of nuclear physics has made the revision and enlargement of the table of isotopes necessary. Other tables have been added.

Modern Glass Working and Laboratory Technique, *(Third Edition) by M. C. Nokes. The Chemical Publishing Company, 26 Court Street, Brooklyn 2, New York. Pages, 157. Price, $3.75.*

The introduction of Pyrex and other hard glasses have given the laboratory worker a wide range of powers he has never before known. Before now the manipulation and possibilities of glass have been neglected. The purpose of this book is to give instructions for the working of these new glasses, the strength and efficiency of the apparatus produced being regarded as of more importance than that excellence of finish, which is attained by the professional. Industrial techniques are adapted for use of amateurs.

A Manual of Plastics and Resins, *edited by William Schack. Chemical Publishing Company, Brooklyn, New York. Pages, 547. Price, $10.*

A compact survey of the materials, processes, products, and equipment of the plastics industry, this book contains 1500 subjects, all arranged in alphabetical order. It contains full length articles and short items on products and definitions of basic molding, fabricating, and chemical terms. The major fields of plastics applications are discussed and each item tabulates the components and the specific plastic used for each, and the properties that make it suitable for the purpose.

Synthetic Alkyd Resins, *Patent Publications, Box 4094, Washington 15, D. C. Pages, 15. Price, $4.*

Alkyd type resins are an important unit in the synthetic resin field, and with the idea in view of acquainting manufacturers and users of alkyd resins with all available patent information this group list was published covering every alkyd patent listed by the U. S. Patent Office. The alkyd patents listed are those compositions with polydhydric alcohol, polycarboxylic acid reaction products, with monocarboxylic acid or anhydride thereof, monohydric alcohol.

Colloid Science, *by James W. McBain, Reinhold Publishing Corporation, 330 West 42nd Street, New York, New York. Pages, 450. Price, $8.*

Written by the director of National Chemical Laboratories, Poona, India and former editor of the Journal of Colloid Science, this book is designed to give a clear picture of scientific research in colloids, non-crystalline matter that constitutes such materials as soap solutions, rayon, bakelite, etc., bringing out not only its immense scope but also the main regularities and generalizations that have been established within it. The term colloid is unfamiliar to the aver-

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age person in contrast with such publicized terms as vitamins and atomic energy. There is no mistaking the importance of colloid science in industry, however, and it should not be overlooked. No branch of science offers more varied and striking behavior or more intriguing experimental demonstrations.

The Chemistry of the Nonbenzenoid Hydrocarbons, *(Second Edition), by Benjamin T. Brooks. Reinhold Publishing Corporation, 330 West 42nd Street, New York, New York. Pages, 615. Price, $12.*

This book is a survey of paraffins, olefins, and cyclic hydrocarbons. It contains discussions of the chemistry, properties, methods of synthesis, thermal cracking, oxidation reactions, polymerization, alkylation, and theoretical aspects of the many classes of hydrocarbons having a non-benzenoid structure. Doctor Brooks has prepared this revised edition of his book originally published in 1922, which is regarded highly as a reference book. Advances made in the field are fully covered.

Gas Producers and Blast Furnaces, *by Wilhelm Gumz, published by John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, New York. Pages, 316. Price, $7.*

Although many reports have been written covering the technical development and experimental results of gasification processes, little attention has been paid to the development of theory and calculation methods. This book was written to meet the need for this kind of information. The practical value lies in the fact that adopting calculation methods saves time and expense for unnecessary experiments, shortens the time of development of new types of gas producers, etc. With gasifications of solid fuels in prospect the methods described here have growing importance.

California Fossils for the Field Geologists, *by Hubert G. Schenck and A. Myra Keen, published by Stanford University Press, Stanford University. Pages, 88. Price, $2.*

This handbook, wirebound at the top, is especially convenient for geologists in making rapid and accurate identification of fossils in the field. It contains many plates showing numerous non-marine Mollusca of the late Tertiary and early Quaternary. Three indexes—systematic, stratigraphic, and alphabetic are included. The book was first issued privately in 1940 and has been in popular demand.

Oil and Gas Map of Arkansas. *Prepared by J. W. Sanders, drawn by H. D. Hughes. Oil and Gas Company, Trimble Building, El Dorado, Arkansas. Size 45 in. x 45 in. Price, $3.50.*

The Arkansas Oil and Gas Commission has recently issued an oil and gas map of the state of Arkansas. The map shows the oil, gas, and condensate fields. It also shows oil and gas pipe lines giving their size and ownership. The map may be obtained by writing the Eby Engineering Company, Basement Garrett Hotel, El Dorado, Arkansas.

Principles of Sedimentation, *by W. H. Twenhofel, published by McGraw-Hill Book Company, 330 West 42nd Street, New York 18, New York. Pages, 673. Price, $6.50.*

Fifteen chapters provide geologists, mining engineers and others with information on such topics as: The interrelations of organisms and sediments, classification of sediments and sedimentary rocks and minerals, the causes of deposition, and structural features of sedimentary origin. The book contains also a treatment of the various methods by which sediments are transported from source to site of deposition. It covers the various products that result from operation of sediments and discusses the structures that arise as a result of deposition.

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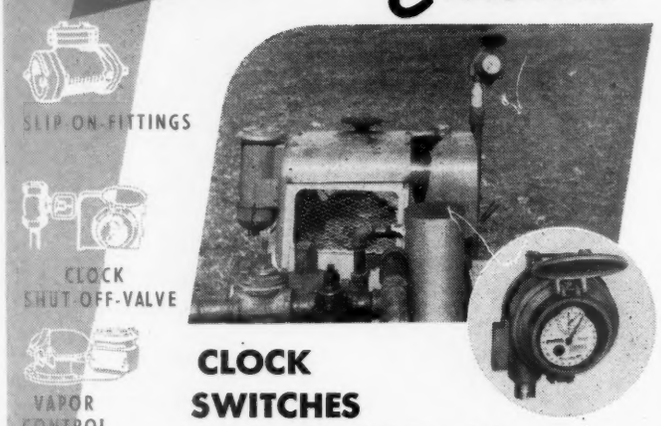

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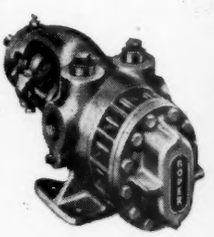
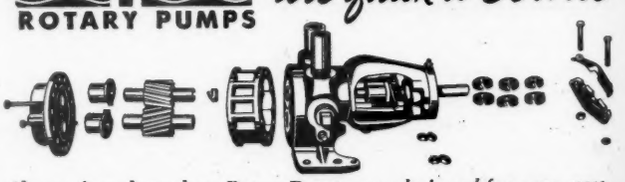


ROPER ROTARY PUMPS are quick to Service



Above view shows how Roper Pumps are designed for easy accessibility. Not necessary to disturb pipe connections or mountings.

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